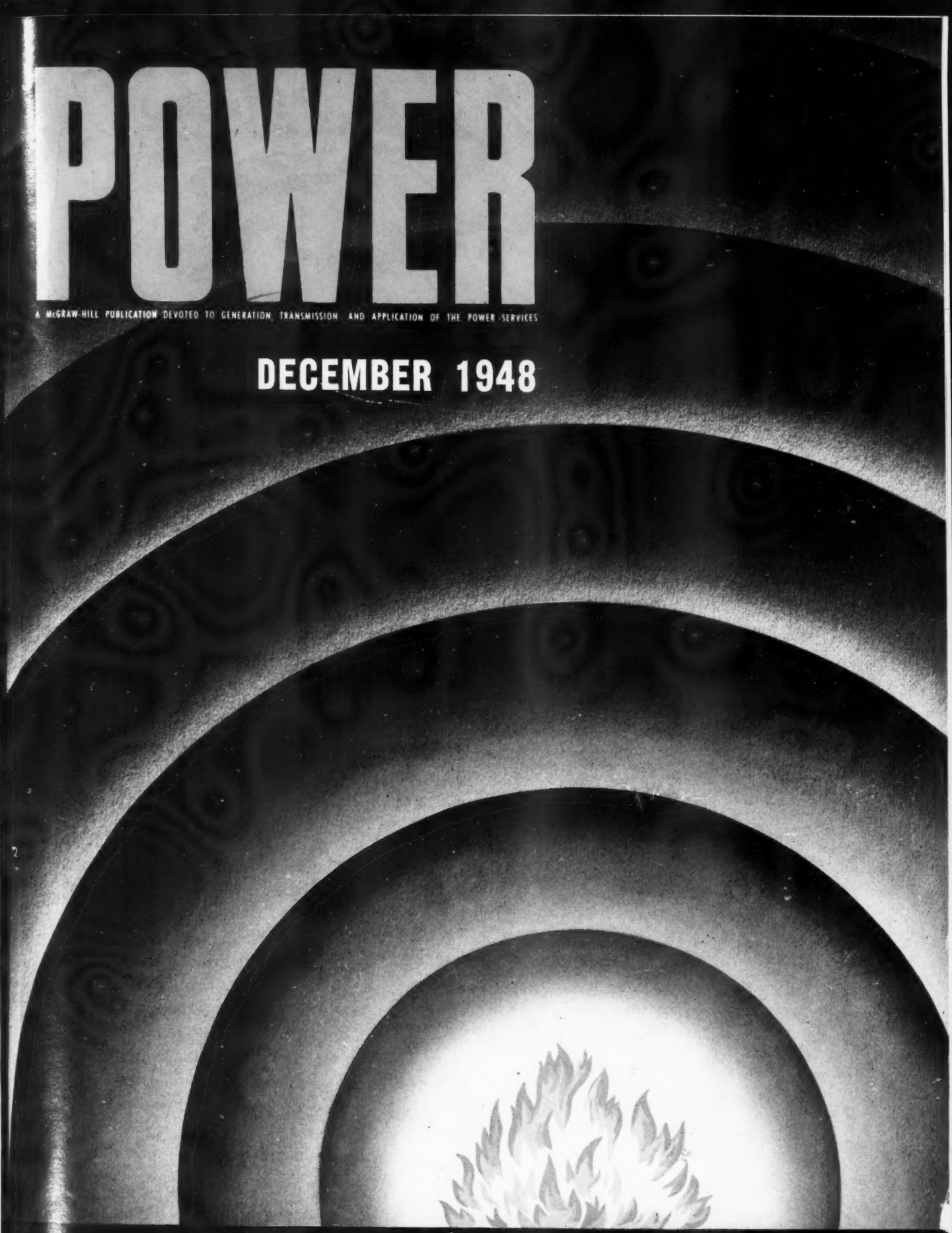
POWER

A McGRAW-HILL PUBLICATION DEVOTED TO GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

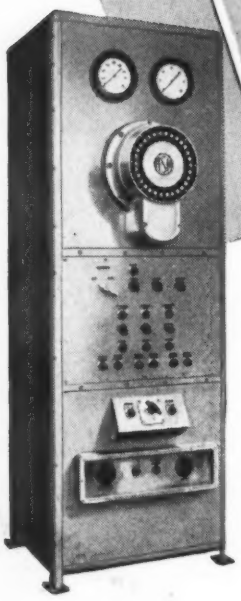
DECEMBER 1948



In this issue: a 48-page Special Section

FUELS and FIRING

Lettin' the Cat outta the Bag!



Left— A-S-H Automatic Sequence Head of the Automatic Sequence Hydrovac. Note that the initials of both are the initials of our company's name, A-S-H, Allen-Sherman-Hoff. This equipment "practically thinks for itself," and while its initial cost is higher than manually operated systems, it is actually more economical in the long run, because of what it saves in time and maintenance. Often it pays for itself in about a year.

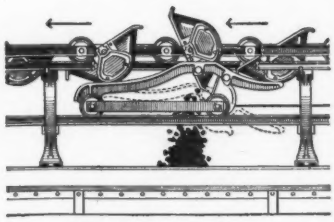
It took five long years of designing, experimenting and building to perfect the new Automatic Sequence Remote Control Hydrovac System for handling anything from the finest dust up to loose, bulk granular materials of various sizes. To the men and companies contributing to this development, quite aptly referred to as the "Pneumatic Materials Handling System of Tomorrow," we express our heartfelt thanks. . . . We are "Lettin' the Cat Outta the Bag" with the publishing of a new catalog, covering manual and automatic systems for handling material in metal and non-metallic mines, coal burning generating and heating plants, process industries, etc. . . . A letter from you will bring one of the catalogs very promptly. If your problem is urgent, tell us in the letter that you want an engineer to bring the catalog and discuss your particular job with you.

ALLEN-SHERMAN-HOFF CO., 227 S. 15th ST., PHILADELPHIA 2, PA. ***Offices & Representatives in Principal Cities***

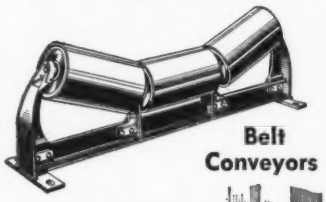
POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," "The Stationary Engineer"), December, 1948, Vol. 92, No. 12. Published monthly with an additional Directory number in June. McGraw-Hill Publishing Company, Inc. Publication office, 99-129 N. Broadway, Albany 1, N. Y. Editorial and executive offices, 330 W. 42nd St., New York 18, N. Y. Entered as second class matter August 25, 1936, at Albany, N. Y., under the act of March 3, 1879. Printed in U.S.A. Allow at least 10 days for change of address. Subscription rates, U.S. and U.S. possessions, $5 for one year, $7 for two years, 50c per single copy. Canada, $6 for one year, $9 for two years. Pan American Countries, $10 for one year, $16 for two years. All other countries $15 for one year, $25 for two years. Please indicate position and company connection on all subscription orders.

LINK-BELT EQUIPMENT

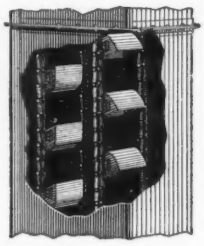
Meets Every Need of Industry in Handling Coal and Ashes



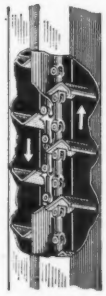
Bucket Carriers



Belt Conveyors



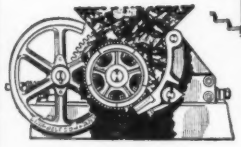
Bucket Elevators



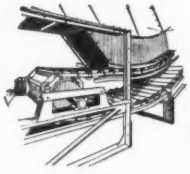
Bulk-Flo

Screw Conveyor

Skip Hoist

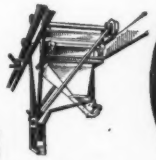


Coal Crusher



Feeders

Car Dumper



Weigh Larry

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DETROIT

Versatile Coal System Handles 450 T.P.H. of Bituminous Slack

This coal handling system is very versatile in that it is arranged to receive coal by river barge or railroad car and convey it to either the boilerhouse bunker or reserve ground-storage, at the rate of 450 tons per hour, as well as handle coal from reserve storage to bunker when necessary. A tank type self-propelled and self-reversing belt tripper operates to distribute the coal inside the plant.

Completely engineered by Link-Belt, the belt conveyor system includes six 36 in. wide units of varying lengths, with three feeder conveyors under receiving hoppers. Link-Belt self-aligning troughing idlers are used at intervals, and Link-Belt differential band brakes are used to prevent backward motion of loaded inclined conveyors in case of power failure.

We'll be glad to give you complete details of this and other power plant coal handling systems. Get in touch with our nearest office.

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

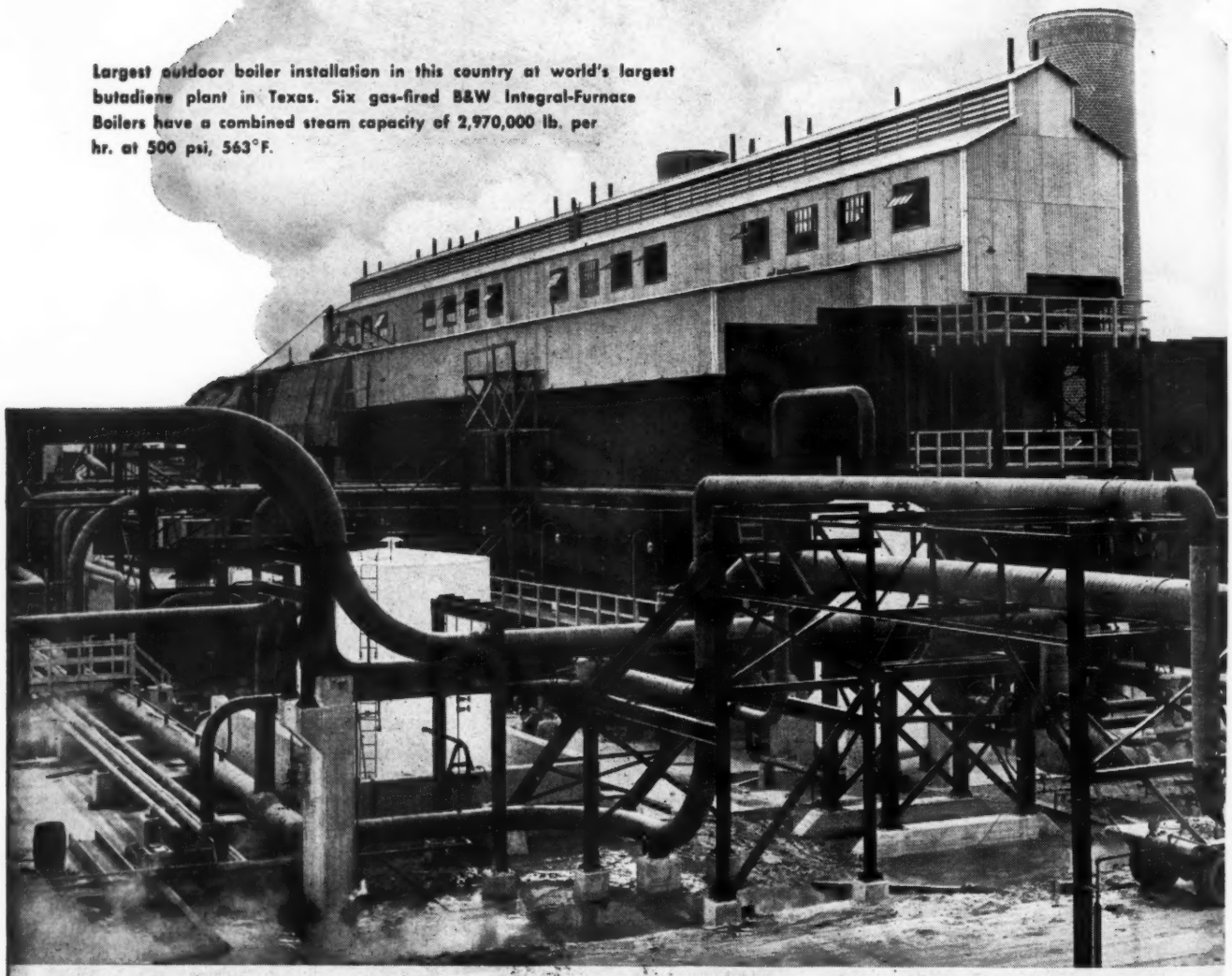
11,183

LINK BELT

THE SYMBOL OF QUALITY — LB — LINK-BELT

COAL AND ASHES HANDLING EQUIPMENT

OUTDOOR BOILERS...



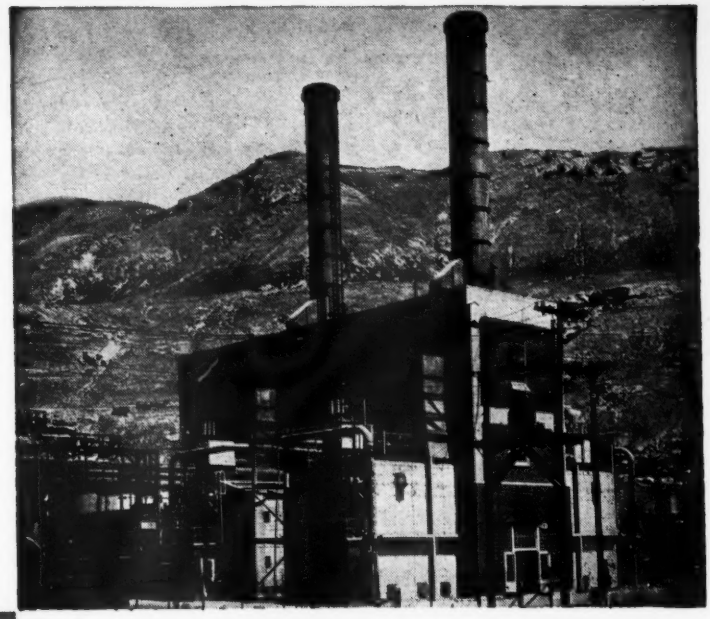
Largest outdoor boiler installation in this country at world's largest butadiene plant in Texas. Six gas-fired B&W Integral-Furnace Boilers have a combined steam capacity of 2,970,000 lb. per hr. at 500 psi, 563°F.

Outdoor and Semi-Outdoor Installations of B&W Boilers

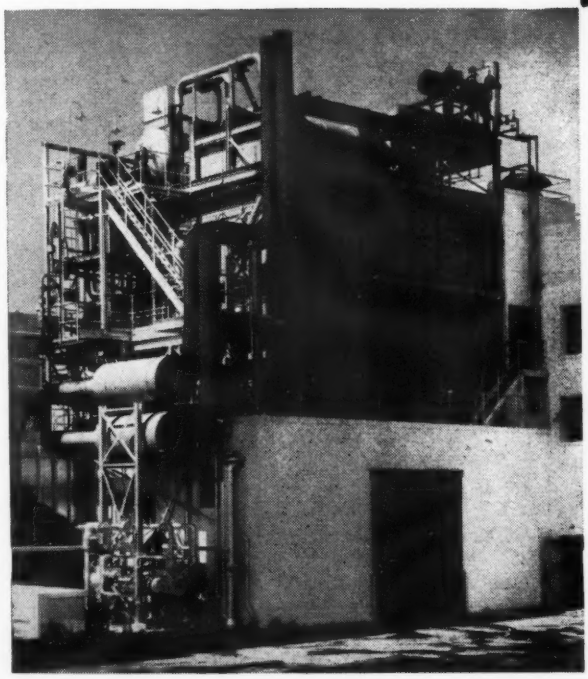
BY INDUSTRY: **Central Station, Oil Refining, Chemical, Rubber, Manufacturing, Textile, Food, Shipbuilding.**

BY LOCATIONS: **Arizona, California, Colorado, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Mississippi, New Jersey, New Mexico, New York, North Carolina, Oklahoma, Oregon, Pennsylvania, Tennessee, Texas, Utah, Argentina, Brazil, Colombia, Cuba, Mexico, Netherland West Indies, Venezuela.**

KEEP POWER COSTS DOWN



Four 65,000 lb. per hr. gas and oil fired B&W Integral-Furnace Boilers installed outdoors at a Utah refinery.



A 200,000 lb. per hr. oil-fired B&W Integral-Furnace Boiler installed outdoors at a central station in Florida.

To keep inflation out of power costs in the face of today's inflated construction costs, public utilities and industrial plants are showing an increasing preference for outdoor boiler installations when additional power facilities are needed. And no wonder. Savings of $5.00 to $10.00 per kilowatt in building costs alone over conventional fully-housed power plants are being realized this way. Still further economies are effected by reduced maintenance and operating expense required with outdoor stations due to their greater simplicity and compactness.

The practicability of leaving boilers outdoors has been amply proved in all kinds of weather, and in temperatures from sub-zero to over 100°F.

B&W has been identified with outdoor power plant installations ever since their inception—has supplied over 200 Integral-Furnace, Radiant and Stirling Boilers for installations of this kind. Their steam capacities range up to 500,000 lb. per hr. at pressures up to 1500 psi and temperatures up to 950°F.

This vast experience of B&W can help you keep inflation out of your power costs.

G-396 T

FOR POWER PLANTS — B&W, Open-Pass, Radiant, Integral-Furnace, Cross-Drum, Stirling and Waste-Heat Stationary Boilers . . . Air Heaters . . . Economizers . . . Superheaters . . . Water-Cooled Furnaces . . . Oil, Gas & Multifuel Burners . . . Chain-Grate Stokers . . . Stacks and Breechings . . . Seamless & Welded Tubes for All Pressure and Mechanical Applications . . . Refractories . . . Chemical Recovery Units . . . Alloy Castings.

★ ★ ★

OTHER B&W PRODUCTS — Marine Boilers . . . Pressure Vessels . . . Process Equipment

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
GENERAL OFFICES: 85 LIBERTY ST., NEW YORK 6, N.Y.
WORKS: ALLIANCE AND BARBERTON, O.; AUGUSTA, GA.

THE NEW

Elliott

SPRAY TRAY DEAERATING HEATER

Double

Reg. U.S. Pat. Off.

ELLIOTT COMPANY PLANTS AT: JEANNETTE, PA RIDGW

play in deaeration!

OUT—with corrosive gases —with maintenance costs

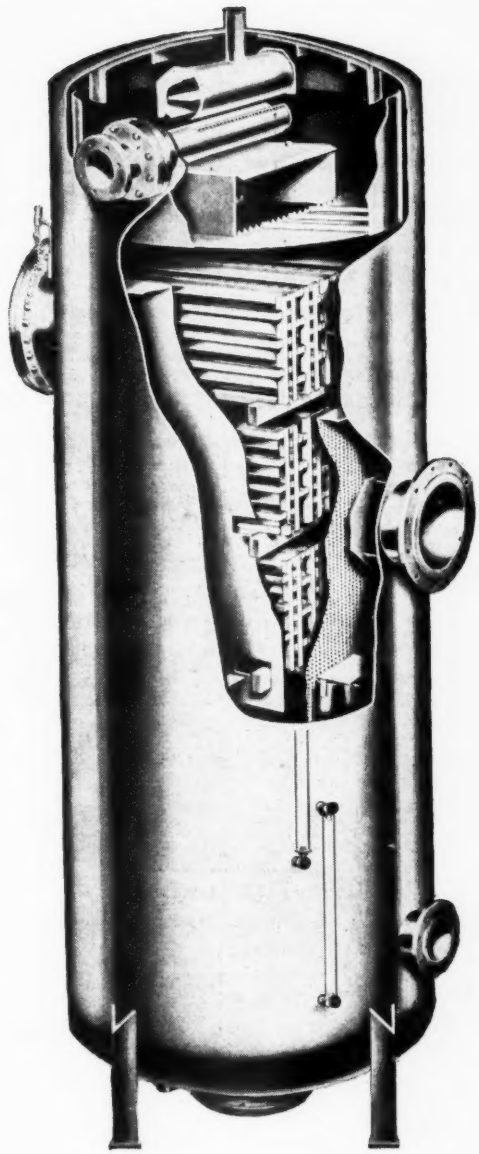
To eliminate the corrosion-causing oxygen in feedwater is in itself a notable achievement. To eliminate also the major factor in deaeration equipment upkeep, provides a two-way saving worthy of deep consideration by power plant executives. This is the combined result obtained in the new Elliott spray-tray deaerating heater.

This unit, for the first time in deaeration history, makes the tubular vent condenser nonessential, and replaces this maintenance-causing element with a stainless steel vent collecting hood contained within the shell of the unit, which operates without attention and is immune to the corrosive action of the gases which it expels. It simply means deaeration without the upkeep cost formerly accepted as normal.

The deaerating trays, too, are of fabricated stainless steel—lighter, stronger, and equally corrosion-resistant; more saving in upkeep.

And, of course, you get feedwater heated to the saturated temperature of the steam supplied to the heater.

All in all, another step ahead in power progress, by an organization which pioneered deaeration some years ago, and is still breaking trail.



For Complete Details, Write for Bulletin PN-16

Address:

TECHNICAL DATA DEPT.
ELLIOTT COMPANY, JEANNETTE, PA.

N-994

85% of THESE INSTALLATIONS that have soot blower

1948 Listing of Typical Central-Station

For Notes on Uses and Limitations of this Tabulation • See page 122

Compiled by B G A Skrotzki, Associate Editor

Company	Location	Plant Name	
1500 PSI AND ABOVE			
Appalachian Elec Pwr Co	Graham Sta, W. Va	Philip Sporn	Ame
The Ohio Power Co	Graham Sta, W. Va	Philip Sporn	Ame
Indiana & Mich Elec Co	Mishawaka, Ind	Twin Branch	Ame
City of Detroit Pub Ltg Comm	Detroit, Mich	Mistersky	SH &
Consolidated Edison Co of N Y	Manhattan, N. Y. C.	Waterside No. 1	
Consolidated Edison Co of N Y	Bronx, N. Y. C.	Sherman Creek	
Columbus & So. Ohio Elec Co	Nr. Athens, Ohio	Poston	Ebas
Consolidated Edison Co of N Y	Manhattan, N. Y. C.	East River	
Iowa Power & Light Co	Des Moines, Iowa	Des Moines No. 2	
1200 PSI TO 1499 PSI			
Boston Edison Co	Weymouth, Mass	Edgar	Jack
Buffalo Niagara Elec Corp	Dunkirk, N. Y.	Dunkirk	
Metropolitan Edison Co	Reading, Pa	Titus	Gilbe
New England Power Co	Salem, Mass	Salem Harbor	Unite
The Ohio Power Co	Brilliant, Ohio	Tidd	Ame
Florida Power & Light Co	Cutler, Fla	Cutler	Ebas
City Public Service Board	San Antonio, Texas	Mission Road	Gibb
Pacific Gas & Electric Co	Bakersfield, Calif	Kern	Stone
West Penn Power Co	Nr. Courtney, Pa	Mitchell	Sand
West Penn Power Co	Springdale, Pa	Springdale	Sand
Nebraska Public Power System	Bellevue, Nebr	Bellevue	Sarge
Pacific Gas & Electric Co	San Francisco, Calif	Station P	Stone
Cambridge Electric Light Co	Cambridge, Mass	Kendall Sq	Gilbe
The Dayton Power & Light Co	Miamisburg, Ohio	O H Hutchings	Ebas
The Detroit Edison Co	Trenton, Mich	Trenton Channel	
Wisconsin Electric Power Co	Port Washington, Wis	Port Washington	
Buffalo Niagara Elec Corp	Nr. Buffalo, N. Y.	C R Huntley	
Central New York Power Corp	Oswego, N. Y.	Oswego	
The Cincinnati Gas & Elec Co	Cincinnati, Ohio	West End	
The Cincinnati Gas & Elec Co	Columbia Park, Ohio	Columbia	Sarge
N.Y.C. Board of Transportation	Manhattan, N. Y. C.	59th Street	Burns
Duke Power Co	Cliffside, N. C.	Cliffside	
Duke Power Co	Leaksville, N. C.	Dan River	
Connecticut Light & Power Co	Devon, Conn	Devon	Unite
Long Island Lighting Co	Port Jefferson, L. I.	Port Jefferson	Ebas
New Orleans Pub Service, Inc	New Orleans, La	Industrial Canal	Ebas
Oklahoma Gas & Elec Co	Harrah, Oklahoma	Horseshoe Lake	Sande
Rochester Gas & Electric Corp	Nr. Charlotte, N. Y.	Lakeside	Pione
Narragansett Electric Co	Providence, R. I.	Manchester St	Gilbe
900 PSI TO 1199 PSI			Unite
Arkansas Power & Light Co	Lake Catherine, Ark	Lake Catherine	Ebas
Los Angeles Dept of Water & Pwr	Wilmington, Calif	Harbor	
Gulf States Utilities Co	Lake Charles, La	Riverside	Stone
	Baton Rouge, La	Louisiana[34]	Stone
	Beaumont, Texas	Neches	Stone
Florida Power & Light Co	Miami, Florida	Miami	Ebas
Louisiana Power & Light Co	Sterlington, La	Sterlington	Ebas
Columbus & So. Ohio Elec Co	Nr. Columbus, Ohio	Picway	
Duquesne Light Co	So. Heights, Pa	Phillips	

A	—Air cooled	*CA*	—Coal, anthracite
AAlBr	—Arsenical aluminum-brass	*CB*	—Coke breeze
AAd	—Arsenical admiralty	*CE*	—Combustion Engineering Co
AlB	—Aluminum-bronze	*CuNi*	—Cupro-nickel
AlBr	—Aluminum-brass	*Cu*	—Copper
AC	—Allis-Chalmers Mfg Co	*DL*	—DeLaval Steam Turbine Co
Ad	—Admiralty	*D*	—Damper
Ads	—Admiralty, stabilized	*DB*	—Dry bottom
AnAd	—Antimony-admiralty	*EC*	—Erie City Iron Works
AsCu	—Arsenical copper	*El*	—Elliott Co
B&R	—Burns and Roe	*EM*	—Edge Moor Iron Works
BW	—Babcock & Wilcox Co	*FW*	—Foster Wheeler Corp
C	—Coal, bituminous	*G*	—Natural gas

1948 Listing of Typica

For Notes on Uses and Limitations of this Tabulation • See page 122

Compiled by B G A Skrotzki, Associate Editor

Company	Location	Plant Name	Consulting Engineers
Houston Lighting & Power Co	Houston, Texas	Greens Bayou	Ebasco Services
Jersey Central Power & Light Co	Sayreville, N. J.	Raritan River	Burns & Roe
Kentucky Utilities Co	Tyrone, Ky	Tyrone	Sargent & Lundy
Georgia Power Co	Harryat, Ga	Atkinson	Commonwealth & Sou
Bd Water & Elec Light Comm	Lansing, Mich	Ottawa St	Burns & Roe
Public Svc Co of Colorado	Denver, Colorado	Lacombe	Electric Advisors
Public Service Co of N. H.	Portsmouth, N. H.	Resistance[17]	A A Winters
Georgia Power Co	Arkwright, Ga	Arkwright	Comm & Southern
800 PSI TO 899 PSI			
Rockland Light & Power Co	Tomkins Cove, N. Y.	Hudson	Burns & Roe
Braddock Light & Power Co, Inc	Alexandria, Va	Station C	Stone & Webster
City of Burbank	Burbank, Calif	Burbank	C A Heinze
Virginia Electric & Power Co	Wheelwright, Va	Chesterfield	Stone & Webster
Virginia Electric & Power Co	Possum Point, Va	Possum Point	Stone & Webster
Connecticut Light & Power Co	Uncasville, Conn	Montville	United Engr & Const
	Devon, Conn	Devon	United Engr & Const
Alabama Power Co	Gadsden, Ala	Gadsden	Comm & Southern
Mississippi Power Co	Hattiesburg, Miss	Eaton	Comm & Southern
Public Serv Co of Indiana	Noblesville, Ind	Noblesville	Sargent & Lundy
Empire District Elec Co of Kan	Riverton, Kan	Riverton	Black & Veatch
Kentucky Utilities Co	Green River, Ky	Green River	Sargent & Lundy
Florida Power Corp	Enterprise, Fla	Geo E Turner	J G White Engrg Co
Florida Power Corp	Inglis, Fla	Inglis	J G White Engrg Co
Central Illinois Light Co	East Peoria, Ill	R S Wallace	Comm & Southern
Central Illinois Pub Serv Co	Meredosia, Ill	Meredosia	Sargent & Lundy
Central Power and Light Co	Corpus Christi, Tex	Nueces Bay	Sargent & Lundy
Cons Gas, Elec Lt & Pwr Co, Balt	Baltimore, Md	Westport	
Dairyland Power Cooperative	Alma, Wis	Alma	Vern E Alden
Ohio Public Service Co	Shadyside, Ohio	R E Burger	Electric Advisors
N Y State Elec & Gas Corp	Dresden, N. Y.	Greenidge	Gilbert Assoc
Arkansas-Missouri Power Co	Campbell, Mo	Jim Hill	Eossco Services
Union Electric Power Co	Venice, Ill	Venice No. 2	Stone & Webster
Mississippi Power & Light Co	Nr Jackson, Miss	Rex Brown	Ebasco Services
New Bedford Gas & Edison Lt Co	New Bedford, Mass	Cannon Street	Gilbert Assoc
Kansas Gas & Electric Co	Wichita, Kan	Ripley	Ebasco Services
The Hartford Electric Light Co	Hartford, Conn	South Meadow	Stone & Webster
Illinois Power Company	Havana, Ill	Havana	Sargent & Lundy
Indianapolis Power & Light Co	Nr Martinsville, Ind	White River	Gibbs & Hill
Interstate Power Company	Lansing, Ia	Lansing	Sargent & Lundy
Iowa-Illinois Gas & Elec Co	Davenport, Iowa	Riverside	United Lt & Rwy
Iowa Public Service Co	Waterloo, Iowa	Maynard	J F Pritchard
City of Jacksonville	Jacksonville, Fla	No. 2	Reynolds, Smith &
City of Lakeland	Lakeland, Fla	Lakeland	Charles Larsen
Louisville Gas & Electric Co	Louisville, Ky	Paddy's Run	Pioneer Serv & En
Metropolitan Edison Co	Middletown, Pa	Crawford	Gilbert Associates
Northern Virginia Power Co	Riverton, Va	Riverton	Sanderson & Porter
Orlando Utilities Comm	Orlando, Fla	Orlando	Robert & Co
City of Pasadena	Pasadena, Calif	Pasadena	O H Hedrick
San Diego Gas & Electric Co	San Diego, Calif	Silver Gate	Pioneer Serv & En
Pennsylvania Electric Co	Warren, Pa	Warren	Gilbert Assoc
Southern California Edison Co	Redondo, Calif	Redondo	Stone & Webster
South Carolina Power Co	Charleston, S. C.	Ingrod	Comm & Southern
Southwestern Gas & Electric Co	Longview, Texas	Knox Lee	Sargent & Lundy
Southwestern Public Service Co	Borger, Texas	Riverview	
Staten Island Edison Corp	Travis, S. I., N. Y.	Arthur Kill	George Fries
Utah Power & Light Co	Carylhurst, Utah	Orem	Ebasco Services
Wisconsin Power & Light Co	Beloit, Wis	Blackhawk	Sargent & Lundy
Minnesota Power & Light Co	Duluth, Minn	Duluth	Ebasco Services
Dallas Power & Light Co	Dallas, Texas	Mt. Creek	Ebasco Services
Dallas Power & Light Co	Dallas, Texas	Dallas	Ebasco Services
Worcester County Electric Co	Worcester, Mass	Webster Street	United Eng & Co
Southern Indiana Gas & Elect Co	Evansville, Ind	Ohio River	Comm & Southern
600 PSI TO 799 PSI			
Central Illinois Elect & Gas Co	Rockford, Ill	Fordam	Stone & Webster
Sioux City Gas & Electric Co	Sioux City, Iowa	Kirk	J F Pritchard

A	—Air cooled	*CA*	—Coal, anthracite
		CB	—Coke breeze

DIAMOND POWER SPECIALTY CORP. etc

AVE DIAMOND SOOT BLOWERS

and Municipal Power-Plant Installations

ntral-Station and Mr In

1948 Listing of Typi

For Notes on Uses and Limitations of this Tabulation • See page 122

Compiled by B G A Skrotzki, Associate Editor

Company	Location	Plant Name	Consulting Engineers
Consolidated Edison Co of N Y	Bronx, N. Y.	Hunts Point	Stone & Webster
Gulf States Utilities Co	Baton Rouge, La.	Louisiana	Stone & Webster
New York State Elec & Gas Corp	Bainbridge, N. Y.	Jennison	Gilbert Assoc
Oklahoma Gas & Electric Co	Ponca City, Okla.	Beerbower	Pioneer Serv & Eng Co.
Eastern Shore Pub Serv of Md	Vienna, Md.	Vienna	United Eng & Const.
Kansas Gas & Electric Co	Wichita, Kan.	Ripley	Ebasco Services
Missouri Utilities Company	Oran, Mo.	Harry Newman	J F Pritchard
Northwestern Public Service Co	Mitchell, S. D.	Mitchell	Sargent & Lundy
Public Service Co of Oklahoma	Weleetka, Okla.	Weleetka	Sargent & Lundy
Southwestern Public Serv Co	Abernathy, Texas	Tuco	
Southwestern Public Serv Co	Amarillo, Texas	East	
Southwestern Public Serv Co	Carlsbad, N. M.	Carlsbad	
Texas Electric Service Co	Monahans, Texas	Permian Basin	Ebasco Services
Texas Electric Service Co	Wichita Falls, Texas	Wichita Falls	Ebasco Services
Kansas City Power & Light Co	Kansas City, Mo.	Grand Avenue	United Lt & Rwy Serv
Iowa Public Service Co	Eagle Grove, Iowa		J F Pritchard
Iowa Public Service Co	Storm Lake, Iowa	Hawkeye	J F Pritchard
Central Louisiana Electric Co	St Landry, La.	Coughlin	Sargent & Lundy
Glendale Public Service Dept	Glendale, Calif.	Glendale	Carl Heinze
Public Service Co of New Mexico	Albuquerque, N. M.	Albuquerque	Stearns, Roger
City of Lubbock	Lubbock, Texas	Lubbock	Truman Green
Missouri Power & Light Co	Mexico, Mo.	Mexico	Black & Veatch
West Texas Utilities Co	Abilene, Texas	Abilene	Sargent & Lundy
Menasha Elec & Water Util	Menasha, Wis.		Laramore & Douglass
600 PSI AND BELOW			
El Paso Electric Co	El Paso, Texas	Rio Grande	Stone & Webster
Provo City	Provo, Utah	Provo City	Burns & McDonnell
City of Crawfordsville	Crawfordsville, Ind.	Crawfordsville	Comm Testing & Engr
Montana-Dakota Utilities Co	Acme, Wyo.	Acme	
Public Utilities Commission	New Ulm, Minn.		J T Rynda, Jr.
Village of Winnetka	Winnetka, Ill.	Winnetka	Sargent & Lundy
Florida Power & Light Co	Lake Monroe, Fla.	Sanford	Ebasco Services
Dept of Utilities	Fremont, Nebr.		Lutz & May
Southwestern Public Service Co	Denver City, Texas	Denver City	
City of Rocky Mount	Rocky Mount, N. C.		W C Olsen
Board of Public Works	Poplar Bluff, Mo.		Rogers Schmidt
Southwestern Electric Service Co	Jacksonville, Texas	Jacksonville	D C Pfeiffer
Water & Electric Dept	McPherson, Kan.	McPherson	
City of Fairbury	Fairbury, Nebr.		Black & Veatch
Greenwood Elec Lt & Water	Greenwood, Miss.		
Town of Wilson	Wilson, N. C.		W C Olsen
City of Thomasville	Thomasville, Ga.	Thomasville	
City of Hagerstown	Hagerstown, Md.		A C Wood & Assoc
City of Hastings	Hastings, Nebr.		Black & Veatch
Greenwood County Elec Pwr Comm.	Chappells, S. C.	Buzzards Roost	G Hill
Manitowoc Public Utilities	Manitowoc, Wis.		
Water & Light Dept	Virginia, Minn.		Laramore & Douglass
Borough of Vineland	Vineland, N. J.		H A Kuljian
Public Service Dept	Moorehead, Minn.		Helmick, Edeskuty
City of Kansas City	Kansas City, Kan.	Quindaro	Burns & McDonnell
Municipal Light & Water	Clay Center, Kan.		A C Kirkwood
City of Willmar	Willmar, Minn.	Willmar	Pfeifer & Shults
Municipal Utilities	Sleepy Eye, Minn.		Pfeifer & Shults
Mt. Carmel Public Utility	Mt. Carmel, Ill.	Mt. Carmel	
City of Gainesville	Gainesville, Fla.		Robert & Co.
City of Carlyle	Carlyle, Ill.		
Austin, Minn.	Austin, Minn.		Edeskuty
Atlantic, Iowa	Atlantic, Iowa		Stanley Eng Co
Board of Public Works	Alexandria, Minn.		Pfeifer & Shults
City Light & Water Utilities	Kalamazoo, Mich.		Hubbard Eng Co.
Missouri Public Service Corp	Clinton, Mo.	Clinton	Burns & McDonnell
Missouri Public Service Corp	Sedalia, Mo.	Sedalia	Burns & McDonnell
Otter Tail Power Co	Devils Lake, N. D.	Devils Lake	
The Western Colorado Power Co	Durango, Colo.	Durango	
City of Frankfort	Frankfort, Ind.		Emery, Marker &
City Water & Light	Jonesboro, Ark.		N B Thayer
Sioux City Gas & Elec Co	Sioux City, Iowa	Big Sioux	J F Pritchard
Consolidated Edison Co of N. Y.	Long Island City, N. Y.	Ravenswood	J G White Eng Co
Consolidated Edison Co of N. Y.	Manhattan, N. Y. C.	65th Street	Baker & Spencer
Southwestern Gas & Elec Co	Karnack, Texas	Karnack	Sargent & Lundy
Pacific Power & Light Co	Portland, Ore.	Pittock	Ebasco Services
City of Escanaba	Escanaba, Mich.	Steam Heating	Laramore & Douglass
Westchester Lighting Co	Pelham Manor, N. Y.	Pelham	

—Air cooled CA —Coal, anthracite
CB —Coke breeze

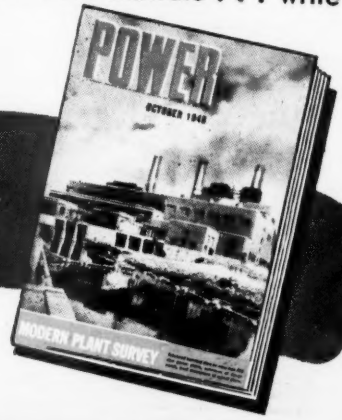
Year after year after year, this OVERWHELMING PREFERENCE continues

A comparison of Power's 1948 Modern Plant Survey (Central Stations and Municipal Power Plants) with our order records reveals that 85% of the installations listed that use soot blowers have selected Diamond Soot Blowers. In the nine previous surveys published by Power since June 1934, the average for Diamond Soot Blowers was 83.5%.

This record is certainly conclusive evidence of continuing complete superiority . . . superiority of product, of application engineering, and of service.

Included in the 85% are all types of Diamond Soot Blower installations . . . from manually operated individual blowers to completely automatic sequential systems. New Catalog No. 1014 describes and illustrates the many features of the various Diamond Soot Blowers . . . write for a copy.

LIST PUBLISHED IN POWER, October, 1948

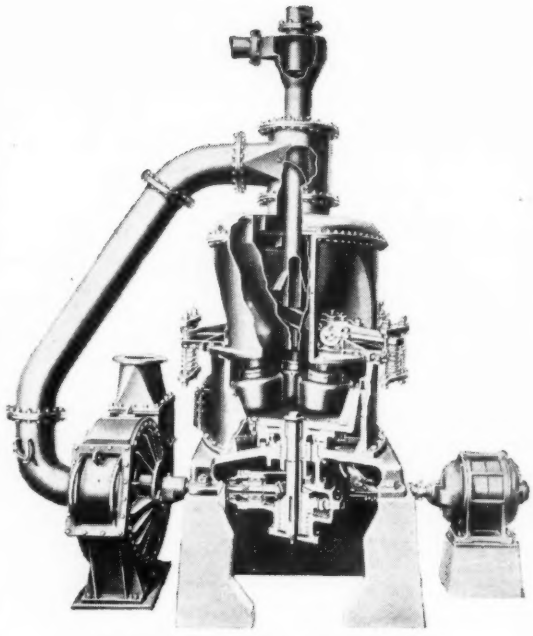


P. etroit 31, Mich. · DIAMOND SPECIALTY LIMITED, WINDSOR, ONTARIO

Headquarters for fuel burning equipment

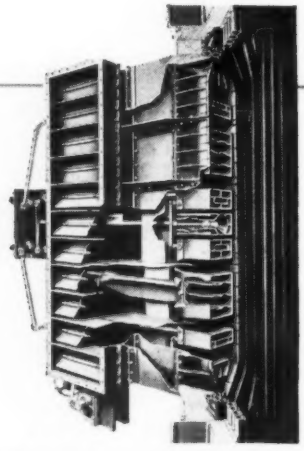
With today's fuel prices what they are, it is more important than ever that your fuel burning equipment be best suited to the fuel most economical for and available to your plant. How then, can you be assured that your particular requirements will be met *exactly?* An obvious step in the right direction is to consult the manufacturer of the world's most complete line of fuel burning equipment — Combustion Engineering.

On this page, for example, are the principal components of C-E Pulverized Coal Systems . . . the C-E Raymond Bowl Mill, widely regarded as the best pulverizer on the market . . . the C-E Vertically-adjustable, Tangential Burner for larger pulverized fuel fired units . . . the C-E Horizontal Burner for smaller and intermediate capacities. And on the opposite page is shown the C-E stoker line comprising every type in general use today — a line which reflects the experience gained through installing more than 20,000 stokers of all types . . . a stoker for every coal that is suitable for stoker firing. B-269

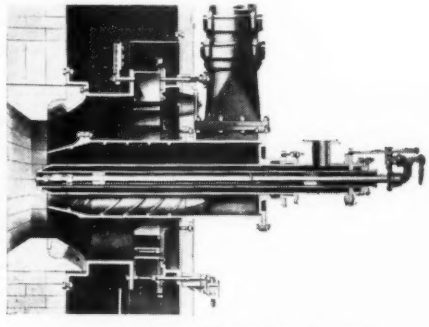


C-E Raymond Bowl Mill (Center Feed)

C·E



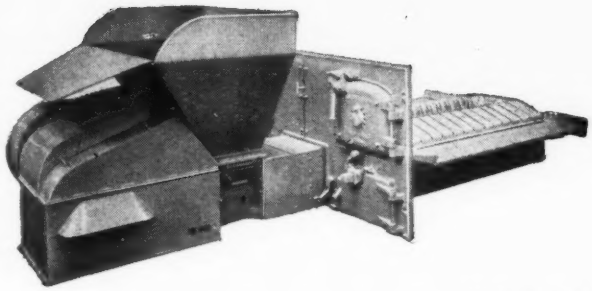
C-E Tangential Burner (Furnace Side)



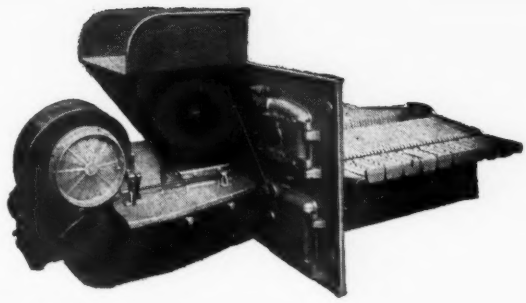
C-E Coal, Oil and Natural Gas Burner

COMBUSTION

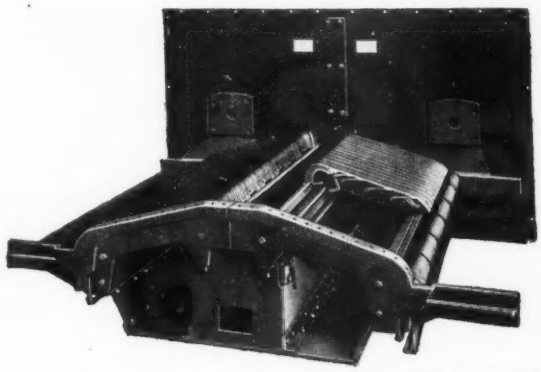
C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS



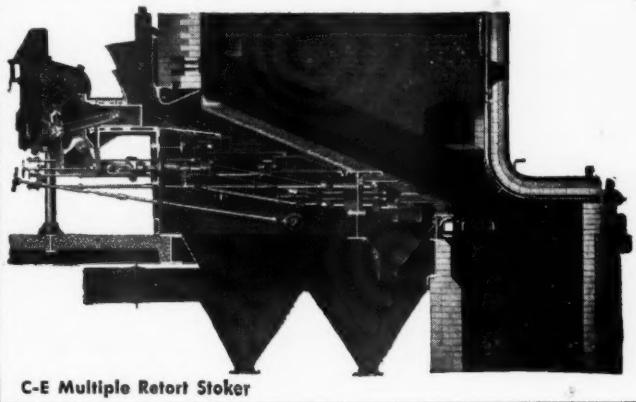
C-E Skelly Stoker



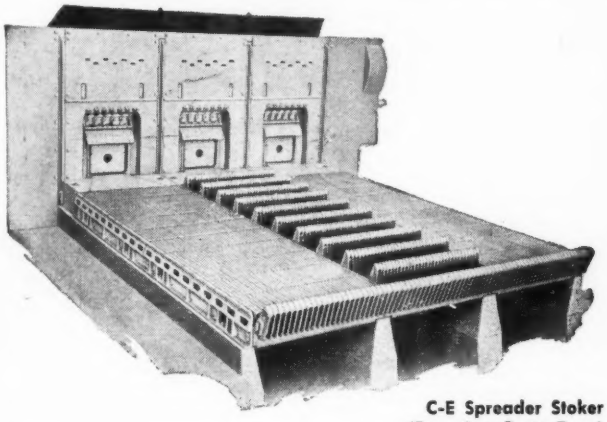
C-E Low Ram Stoker



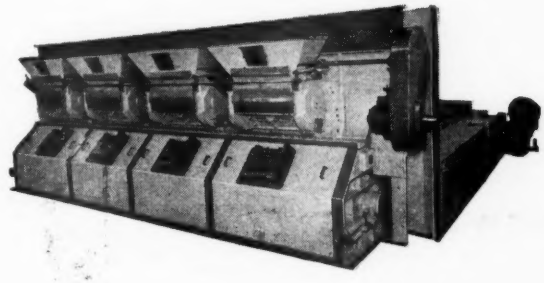
C-E Type E Stoker



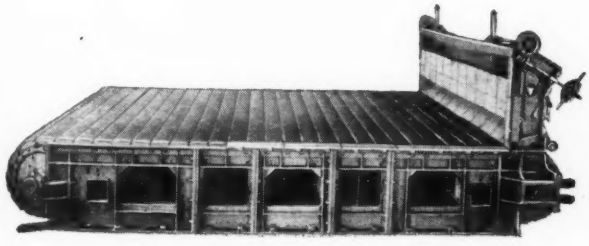
C-E Multiple Retort Stoker



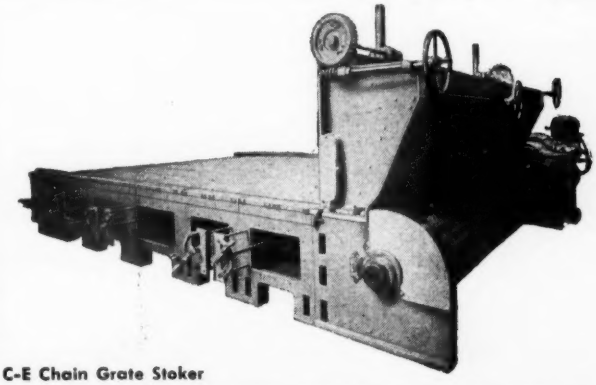
C-E Spreader Stoker
(Dumping Grate Type)



C-E Spreader Stoker
(Continuous Discharge Type)



C-E Traveling Grate Stoker

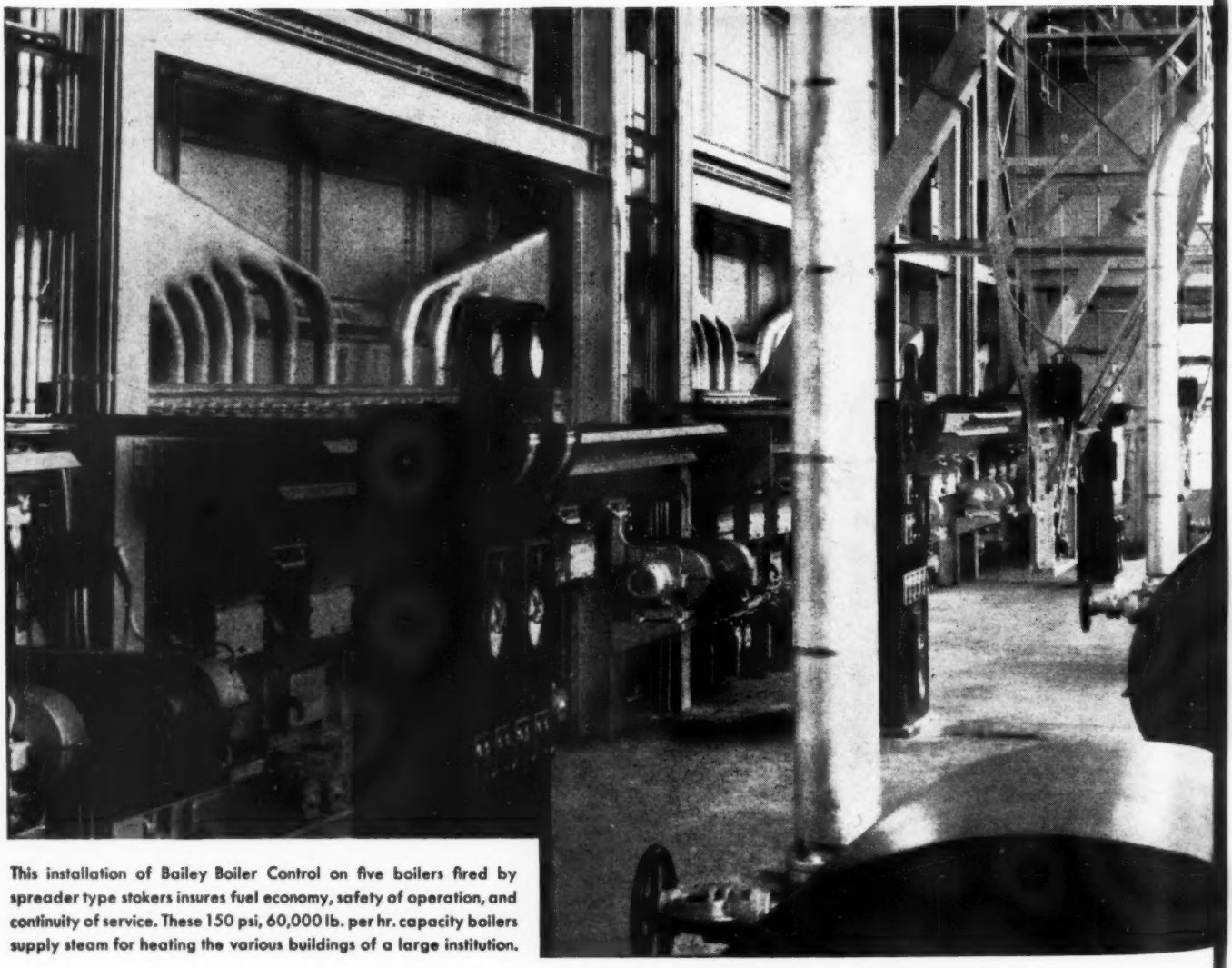


C-E Chain Grate Stoker

ENGINEERING

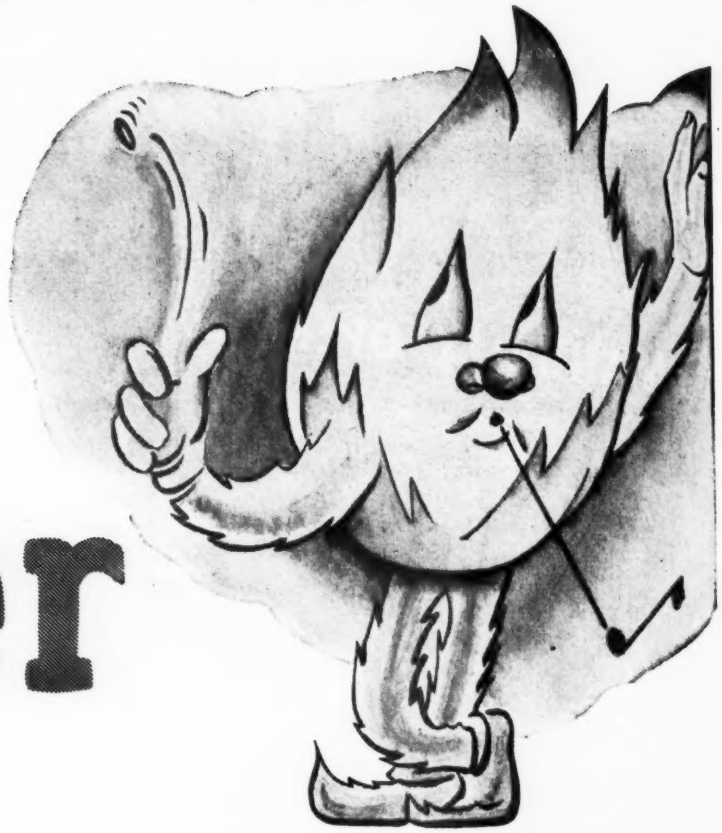
200 MADISON AVENUE, NEW YORK 16, N. Y.

Loafing Btu's produce no



This installation of Bailey Boiler Control on five boilers fired by spreader type stokers insures fuel economy, safety of operation, and continuity of service. These 150 psi, 60,000 lb. per hr. capacity boilers supply steam for heating the various buildings of a large institution.

Branches in: Boston, New York, Schenectady, Philadelphia, Buffalo, Pittsburgh, Cleveland, Detroit, Cincinnati, Atlanta, Chicago, Milwaukee, St. Louis,



power

You find loafers everywhere. Even in a collection of Btu's. You have to *make* them work if you expect to get low cost power. And that is exactly what the Bailey co-ordinated boiler control system is designed to do.

It reduces fuel consumption per pound of steam generated. Combustion, feed water, steam temperature, heater levels, pump speeds and other factors are co-ordinated. Safety of operation is increased — continuity of service is improved. You convert the maximum number of Btu's into power and get all the efficiency your boiler was designed to deliver.

One thing to remember, however, is the fact that this Bailey system is **not** delivered in a standard package. Each one is designed and engineered to the specific job on which it is to be used. That's *why* it functions so efficiently.

If you are looking for low cost power, it will pay you to call our nearest office.

BAILEY METER COMPANY
1036 IVANHOE ROAD • CLEVELAND 10, OHIO
BAILEY METER COMPANY LIMITED, MONTREAL, CANADA

BAILEY METERS

Controls for Steam Plants

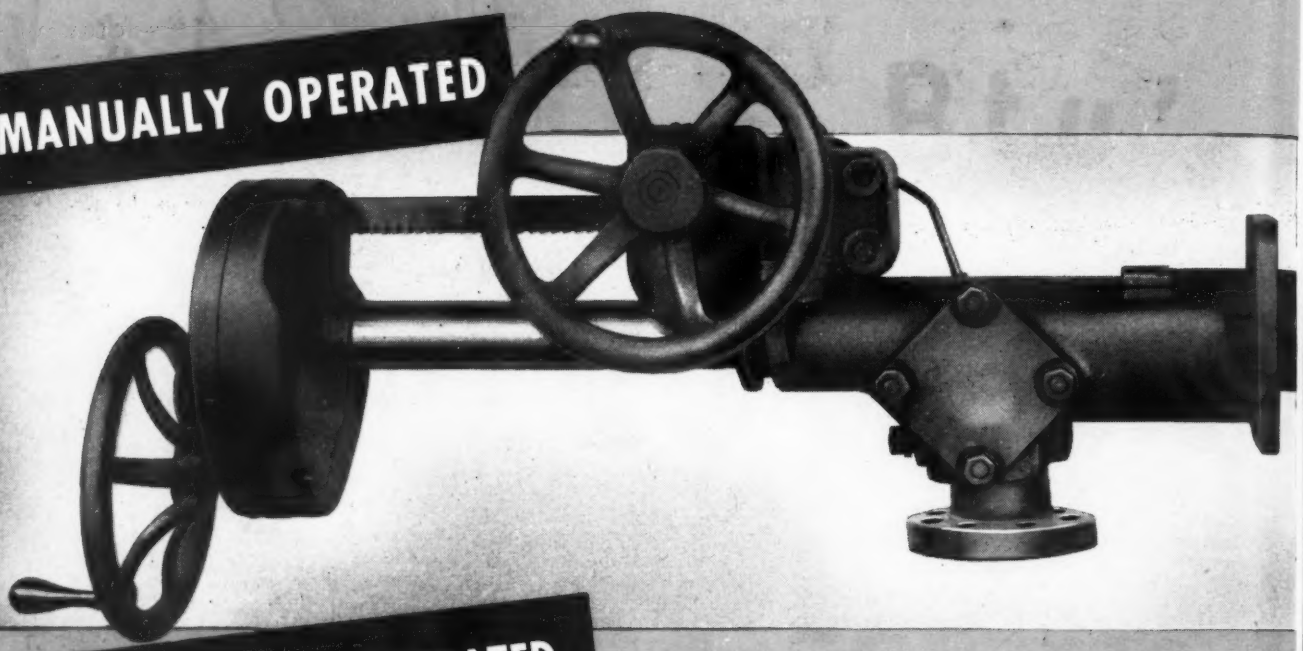
COMBUSTION • FEED WATER • TEMPERATURE
PRESSURE • LIQUID LEVEL • FEED PUMPS

A-104-2

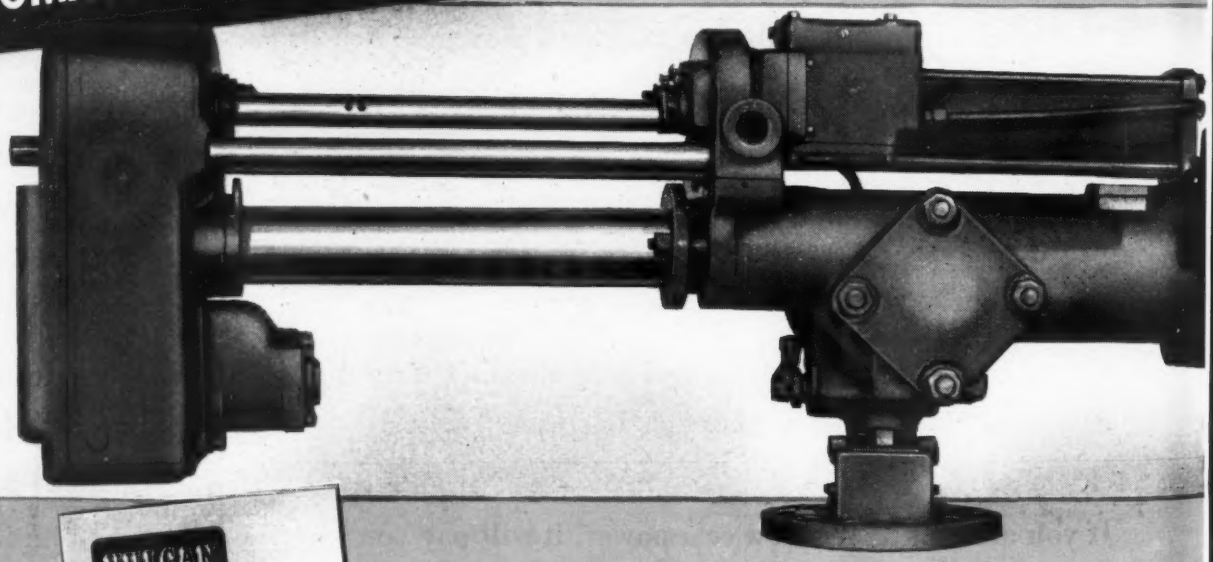
New Orleans, St. Paul, Kansas City, Houston, Denver, Los Angeles, Seattle, San Francisco • Halifax, Montreal, Toronto, Winnepeg, Vancouver

VULCAN GUN

MANUALLY OPERATED



AUTOMATICALLY OPERATED



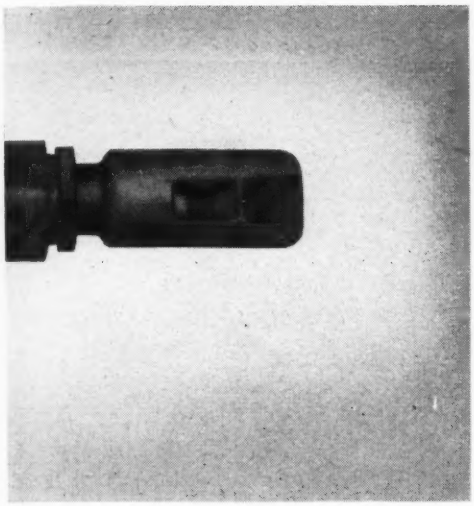
***Above:* Model HG-1 for manual operation.**

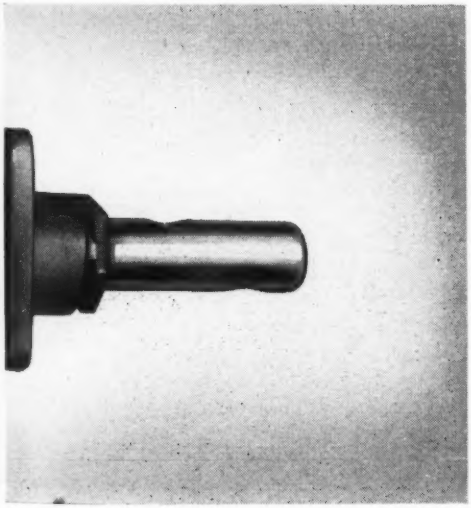
***Below:* Model RW 1 for automatic operation.**

Send for Bulletin No. 471 and see how Vulcan's designs are setting a new standard of soot blower performance.

VULCAN SOOT BLOWER CORPORATION
DUBOIS, PENNSYLVANIA

TYPE BLOWERS····· AND DESLAGGERS···





These rugged units blast hard-to-clean accumulations from boiler, superheater and water-wall locations. Effective cleaning, ease of operation and minimum of maintenance are their outstanding features.

Steam chest design, with large passages, long bearing centers, and pilot valve control, assures efficient handling of large volumes of air or steam.

Wall box, or sleeve, mount adjustment controls axial position and angularity of nozzles, and simplifies adjustment and installation.

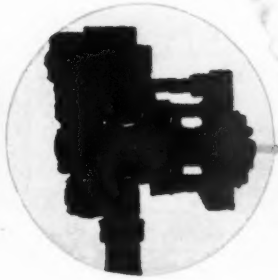
All moving parts are lubricated and two standard travels—12 or 24 inch—are available.

WITH POWER DRIVEN UNITS . . .

- Completely automatic—a simple push of a button operates the blower through its entire cycle and shuts it off without waste of steam or air.
- Working parts are sealed in—protected from dirt and damage and lubrication is continuous.
- Dual controls are provided—at the unit and remote—and retraction is possible at any time during the operating cycle. Depending upon requirements, the unit may be oscillated or rotated continuously in one direction.

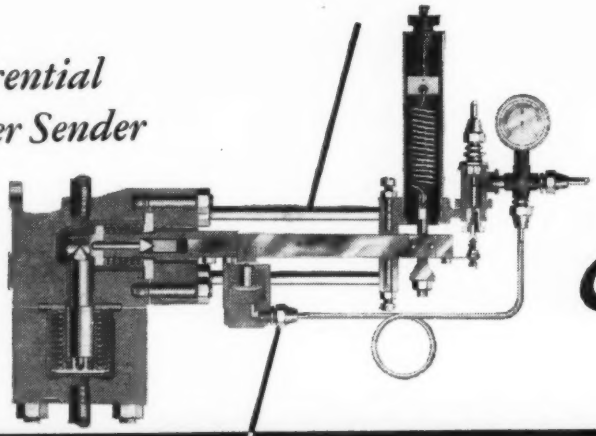
For Power Driven Types RG-1 and RW-1 push button control may be a simple station at the unit or remote, as illustrated, or designed for completely automatic sequential operation. The extreme flexibility of these units and their controls will give you exactly what you want.

VULCAN
STEAM OR AIR

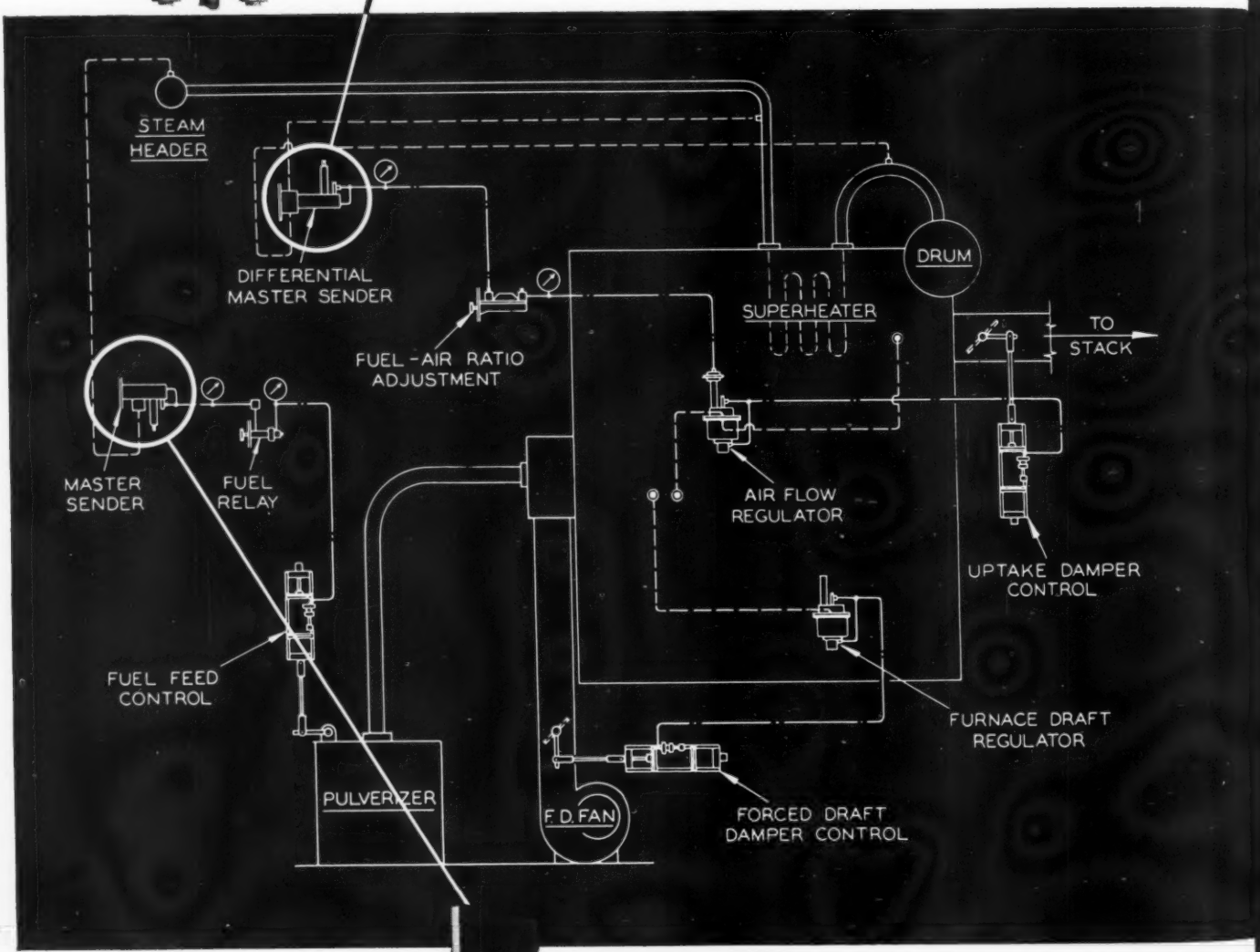


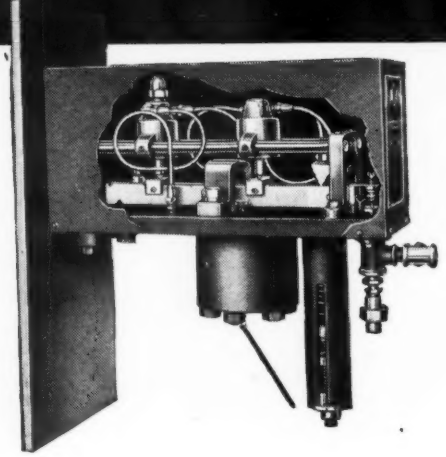
SOOT BLOWERS

Differential Master Sender



simple...





Master Sender

direct... accurate

the Hagan Differential Master Method of automatic combustion control

IN THE firing of pulverized coal, the accurate maintenance of fuel-air ratio has been hampered by such factors as variation in the calorific value of coal, and variation in operation of coal feed mechanisms which are affected by moisture content and coal size.

The Hagan Differential Master method of combustion control automatically maintains proper combustion conditions in a simple and direct way, using the boiler unit itself as a calorimeter of heat input.

A Master Sender, sensitive to steam header pressure, controls the rate of fuel feed so that B.t.u. input is in accordance with demand.

A Differential Master Sender, measuring steam flow, regulates air flow.

These units are not interconnected; each has its own function, and performs that function *directly.* The rate of fuel feed is changed instantly to compensate for any change in steam demand, or variation in calorific value of fuel or in feeder characteristic. Air, however, is changed only when there is an actual change in steam flow.

Control is direct and accurate—there is no necessity for approximate adjustment, to be corrected by a lagging corrector system.

Tested in Service. The Differential Master method has been thoroughly tested in service. It has been applied to boilers burning oil, gas, and pulverized coal, and to multiple fuel boilers. Boiler sizes ranged from 30,000 lbs./hr. at 200 p.s.i. to 900,000 lbs./hr. at 1800 p.s.i. In every instance, results have been entirely satisfactory.

Substantial Fuel Savings. Where the differential master sender can be applied, it gives better control of combustion and substantial savings in fuel. Our engineers will be glad to discuss its possibilities in your plant. Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

HAGAN CORPORATION

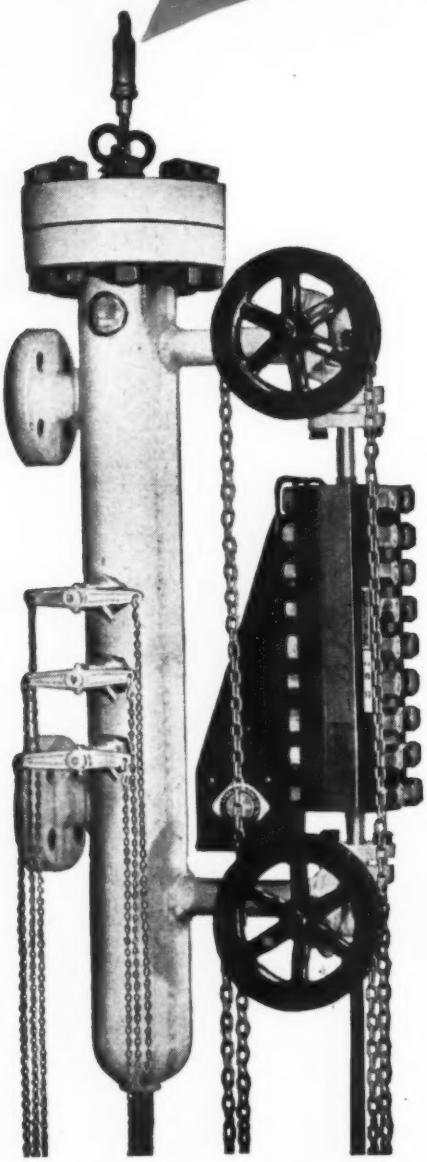
HAGAN
HALL
BUROMIN
CALGON

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

One

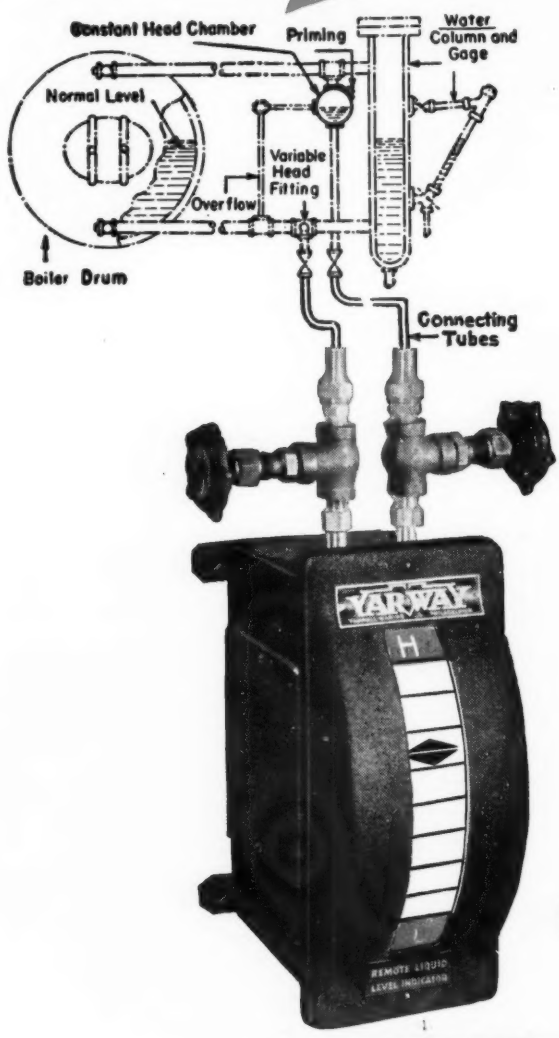
WHEN YOU BUY

YARWAY WATER COLUMNS AND GAGES



A

YARWAY REMOTE BOILER WATER LEVEL INDICATORS



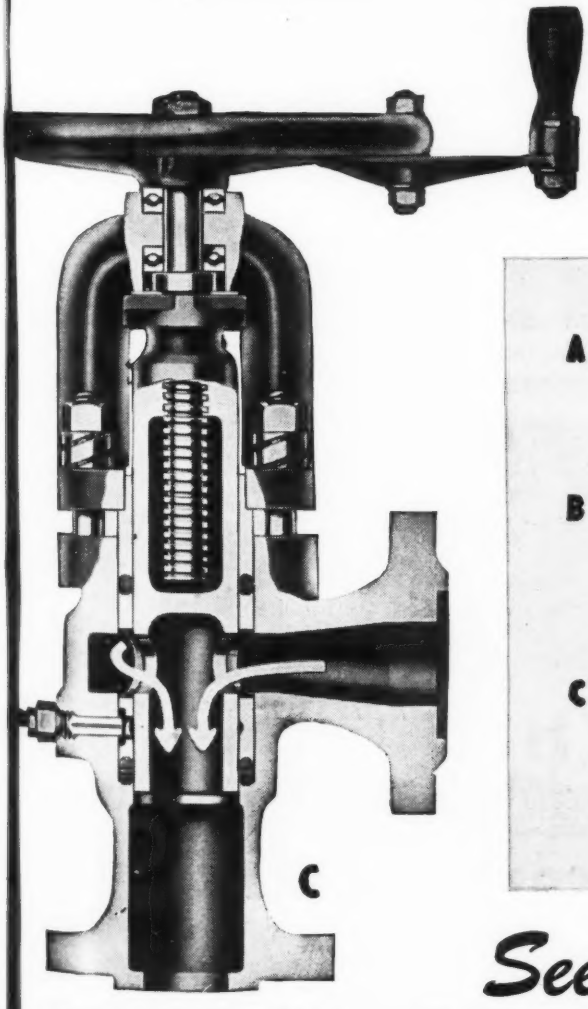
B

YARWAY

RESPONSIBILITY

all 3 FROM

YARWAY BLOW-OFF VALVES



Power plant engineers may simplify responsibility by insisting that all three of these important boiler trim items be Yarway.

Why, you ask?

First, responsibility for the satisfactory performance of all three is centered in one company.

Second, Yarway's extensive service organization, with branches in principal cities in the United States and Canada, is conveniently at your service.

Third, each product has an outstanding feature—an *engineering reason,* laboratory-tested and field-proved for better performance.

For more complete facts on these and other products in the Yarway line of steam plant equipment, write for Yarway's all-products Catalog G-1306.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.

A — Yarway Hi-Lo Alarm *Floatless* Water Column with patented Yarway Flat Glass Gage featuring a "floating assembly" that practically eliminates glass breakage. For pressures from 400 to 2500 psi. Other Yarway Columns and Gages for lower pressures. Write for Yarway Bulletin WG-1811.

B — Yarway Remote Boiler Water Level Indicator that brings overhead readings right down to eye level, on instrument panel or other convenient place. Always accurate because it's operated by the boiler water itself. Action is instant, constant. *No stuffing boxes.* Moderate in price. Easy to install. For all pressures to 1500 psi. Write for Yarway Bulletin WG-1822.

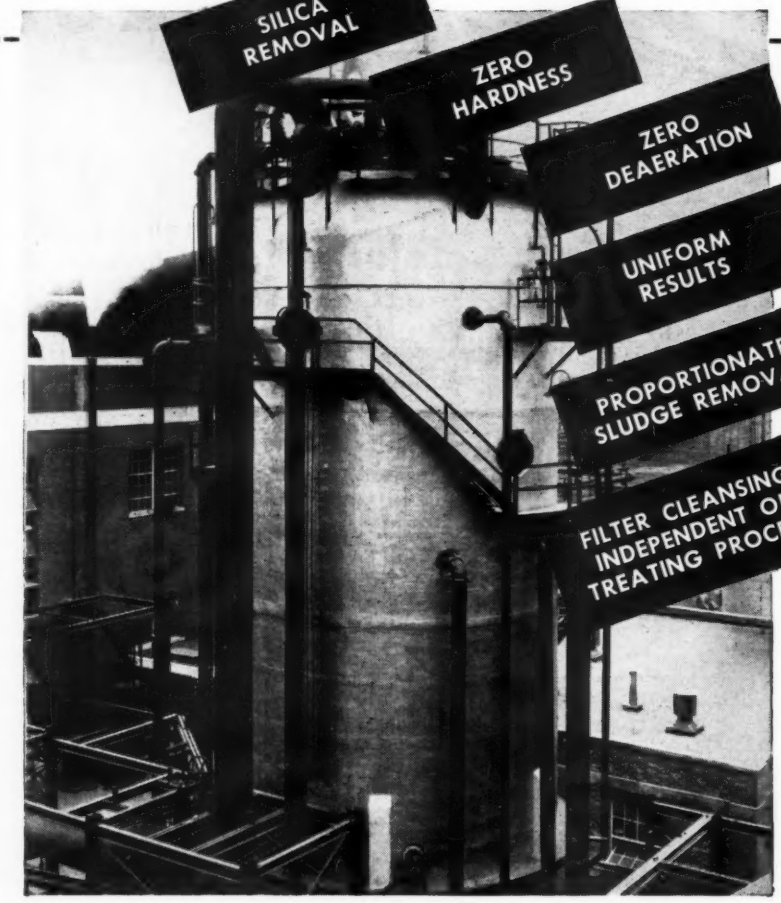
C — Yarway Seatless Blow-Off Valve. No seat to score, wear and clog with mud, scale and dirt. Balanced sliding nitralloy plunger simplifies operation. Also furnished in Tandem, or as a Unit Tandem combined with a Yarway Hard-Seat Valve for highest pressures. Write for Yarway Bulletin B-424 for pressures to 400 psi; Bulletin B-432 for pressures to 2500 psi.

See YARWAY EQUIPMENT AT THE NATIONAL POWER SHOW, NEW YORK, NOV. 29 TO DEC. 4—BOOTHS 65 AND 66

STEAM PLANT EQUIPMENT

No Other Water Conditioning System Has All of These Features...

...ALL IN ONE TANK:



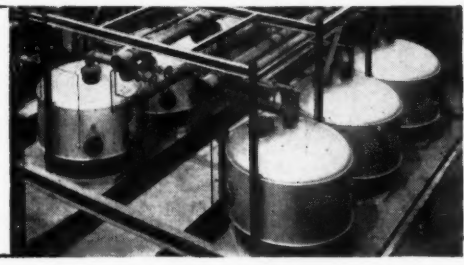
Main treating tank of a Worthington Hot Process Water Conditioning System, capacity 900,000 lb. of treated water per hour

YES, you get all these and more, too, in one tank without the aid of internal mechanical agitation or other moving parts when a water conditioner like this 900,000 lb. per hour Worthington installation treats your make-up or condensate water.

In less space you get all the heating, chemical feeding and clarification facilities to provide optimum water conditioning results. Worthington's engineering skill and complete manufacturing facilities offer you the advantages which can only result from carefully coordinated effort under one responsibility.

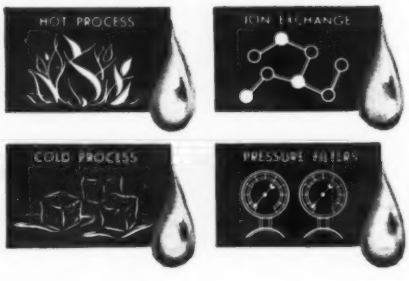
WRITE FOR FACTS

For proof that, in water conditioning as in so many other services, *there's more worth in Worthington*, write for Bulletin W-212-B2. *Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, N.J.*



Six pressure filters 11 feet in diameter used for final clarification in this Worthington Hot Process Water Conditioning System

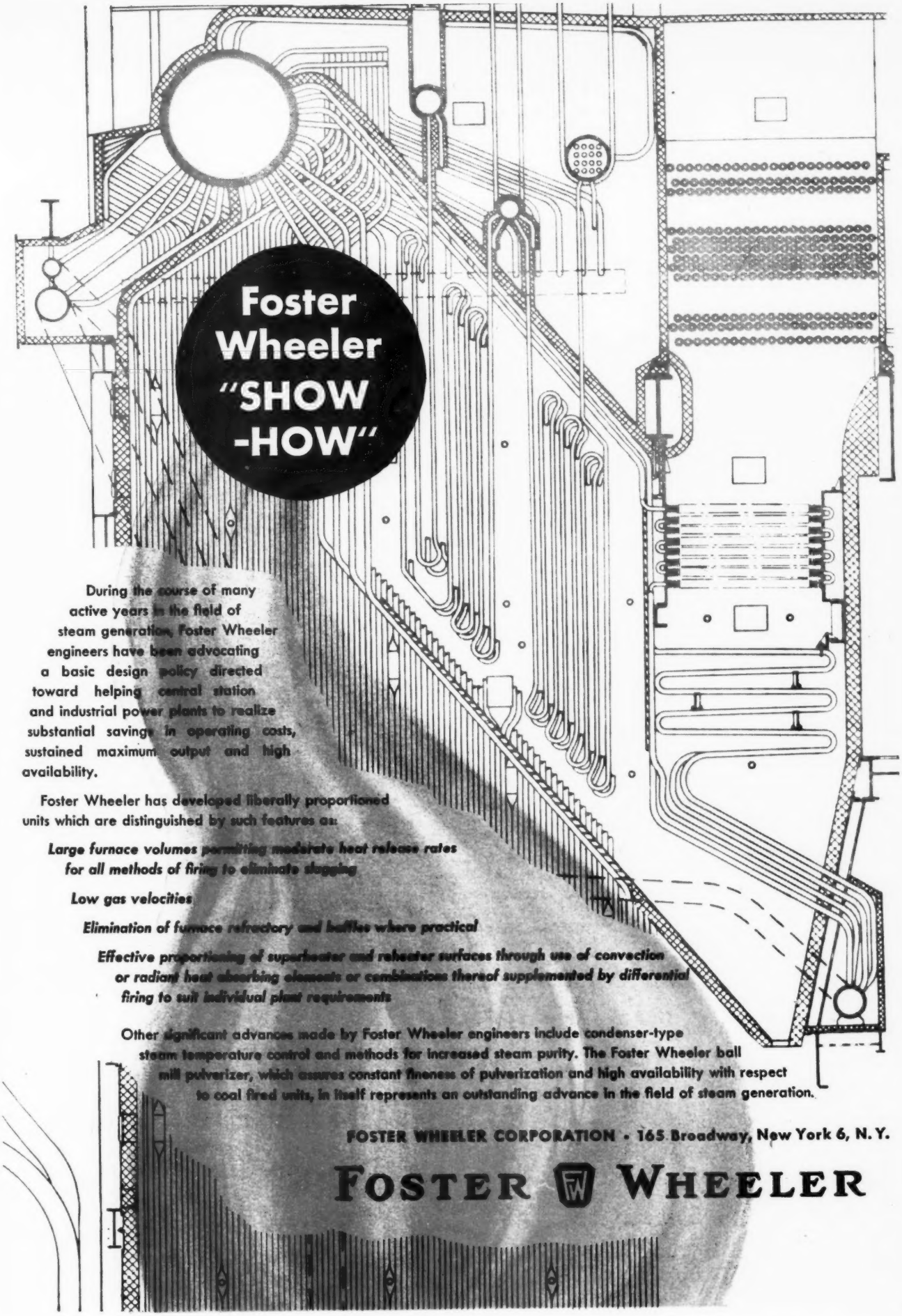
J8-3



WORTHINGTON

WATER CONDITIONING

Worthington Makes More *of the Equipment For All Types of Water Conditioning Systems*



Foster Wheeler "SHOW -HOW"

During the course of many active years in the field of steam generation, Foster Wheeler engineers have been advocating a basic design policy directed toward helping central station and industrial power plants to realize substantial savings in operating costs, sustained maximum output and high availability.

Foster Wheeler has developed liberally proportioned units which are distinguished by such features as:

Large furnace volumes permitting moderate heat release rates for all methods of firing to eliminate slagging

Low gas velocities

Elimination of furnace refractory and baffles where practical

Effective proportioning of superheater and reheater surfaces through use of convection or radiant heat absorbing elements or combinations thereof supplemented by differential firing to suit individual plant requirements

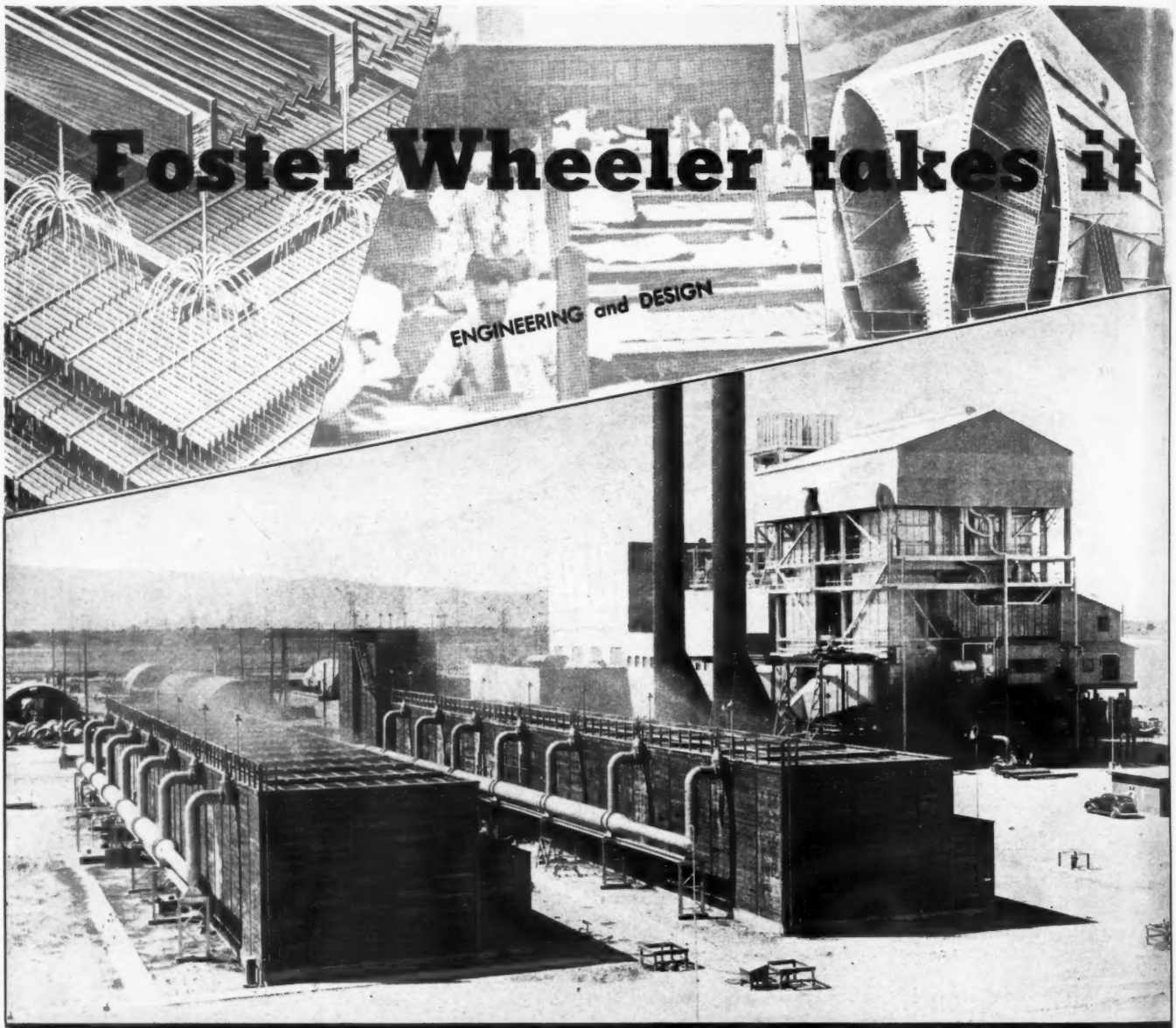
Other significant advances made by Foster Wheeler engineers include condenser-type steam temperature control and methods for increased steam purity. The Foster Wheeler ball mill pulverizer, which assures constant fineness of pulverization and high availability with respect to coal fired units, in itself represents an outstanding advance in the field of steam generation.

FOSTER WHEELER CORPORATION • 165 Broadway, New York 6, N. Y.

FOSTER WHEELER

Foster Wheeler takes it

ENGINEERING and DESIGN



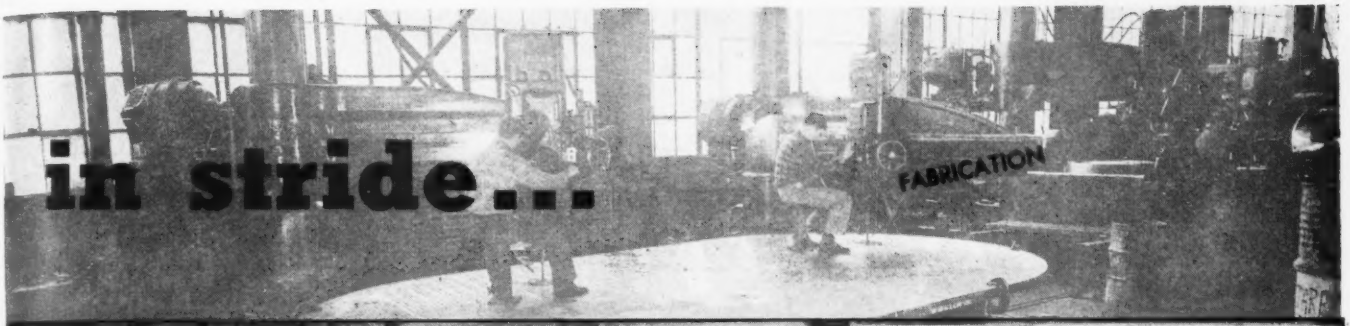
This is the Pacific Gas & Electric Company's Kern station at Bakersfield, California. The two batteries of forced draft cooling towers in the foreground are designed to cool a total of 74,000 gallons of circulating water per minute. Each forced draft tower is designed to cool 37,000 gallons of water per minute from a temperature of 105°F. to a temperature of 91°F. with a wet bulb temperature of 70°F. Each unit, containing 14 cells, is 225' 6" long and 24' 3" high, and is furnished with 14 axial flow fans. In the background are two single cell service water cooling towers.

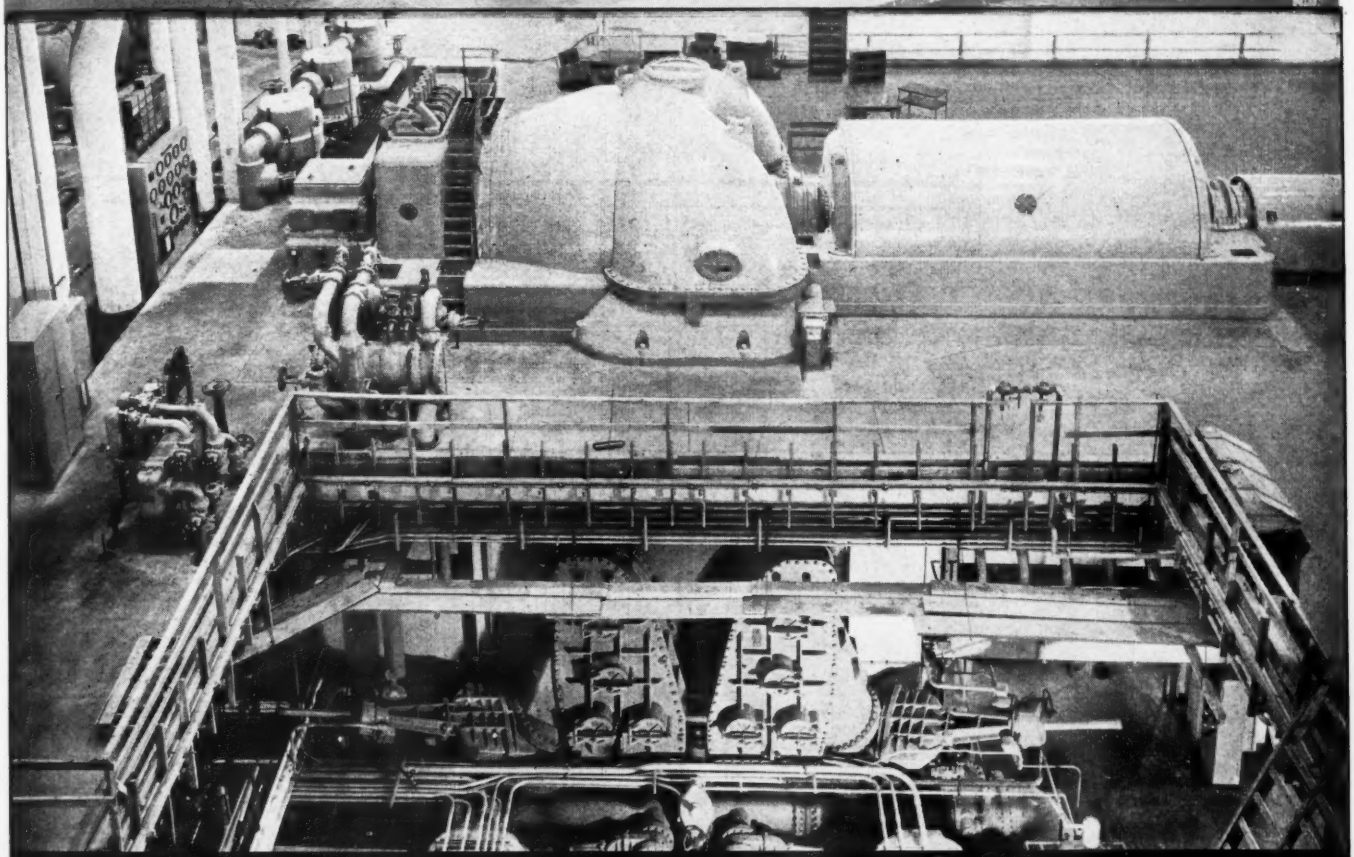
ERECTION

EXTRAORDINARY VERSATILITY AND ORGANIZATION of the highest order are reflected in the project Foster Wheeler recently completed for Pacific Gas & Electric Company's Kern station at Bakersfield, California. The magnitude and complex character of jobs like this require the service of an engineering

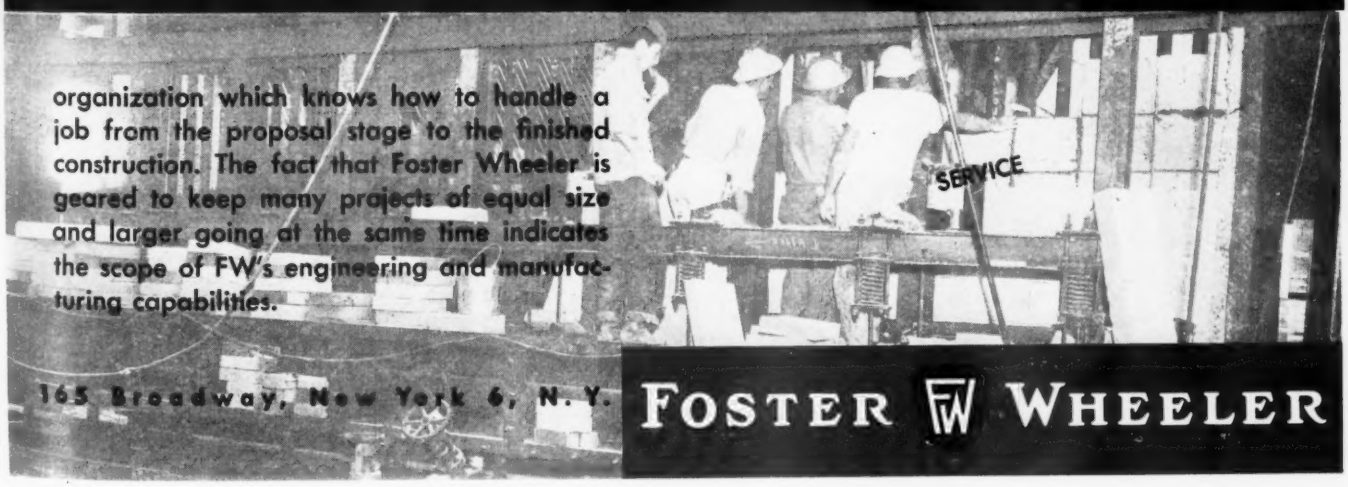
FOSTER WHEELER CORPORATION

in stride...





The divided water box condenser shown above serves a 60,000 kw turbine unit at the Kern Plant. The condenser has an effective length of 26 ft., and contains 35,000 sq. ft. of surface. The cross flow design, providing a central steam lane between the two banks, permits the best possible supply of steam to the hotwell for deaeration and reheat of the condensate. Circulating pumps receive water from the forced draft cooling towers and deliver it to the condenser and back to the cooling tower for re-cooling. Condenser auxiliaries include a 2,000 gallon storage hotwell, twin-element, two-stage steam jet air ejectors, hogging and priming jets, three-stage centrifugal hotwell pumps, and the circulating pumps mentioned above.

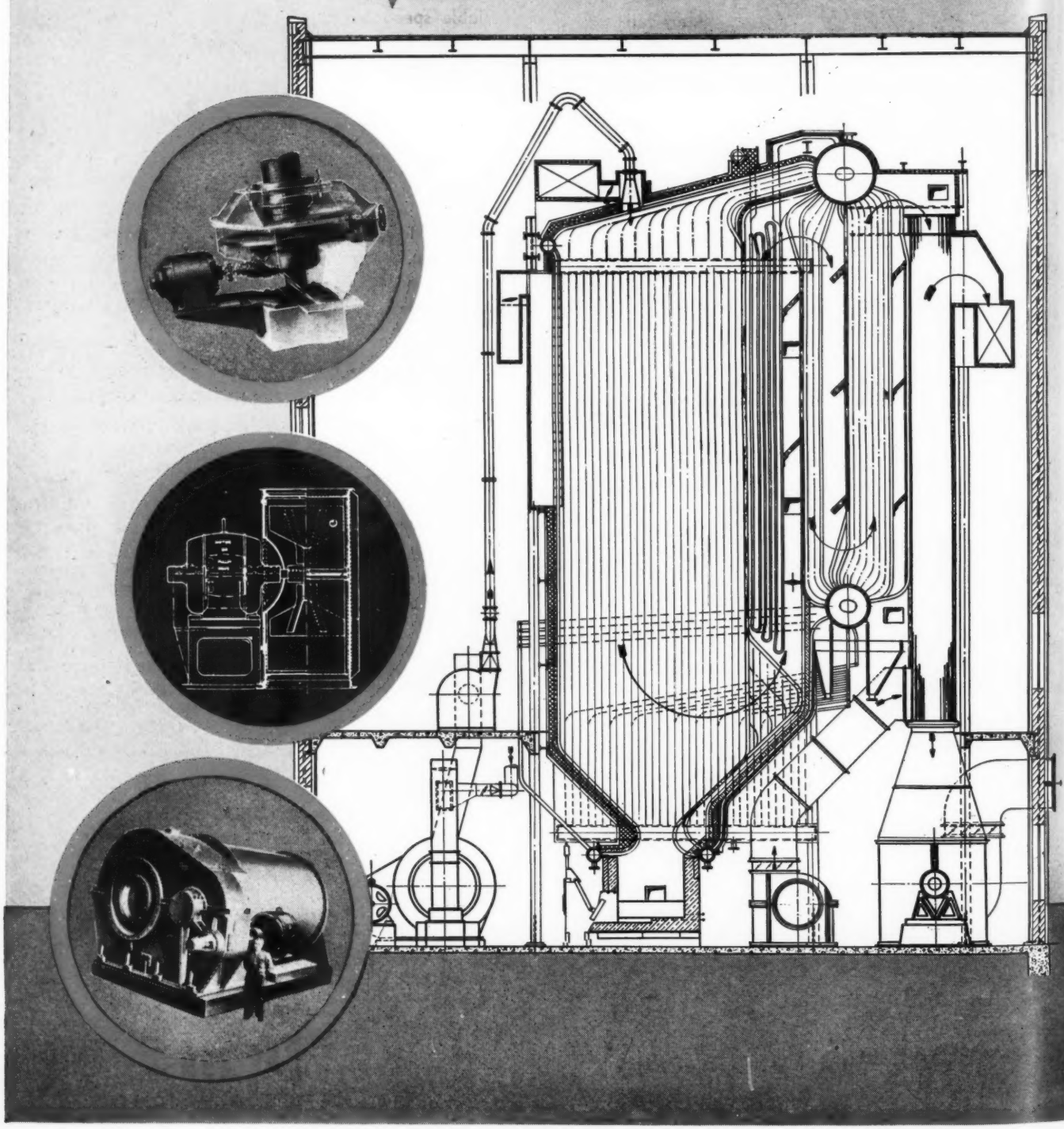


organization which knows how to handle a job from the proposal stage to the finished construction. The fact that Foster Wheeler is geared to keep many projects of equal size and larger going at the same time indicates the scope of FW's engineering and manufacturing capabilities.

165 Broadway, New York 6, N. Y.

FOSTER FW WHEELER

KVE Engineered



d Components...for

ow cost steam generation with available coals.....

FEEDER

The KVS Enclosed Disc Feeder is extremely reliable for feeding coarse or fine material. The rate of feed is varied by changing the position of the knife or by varying the speed of the disc by means of adjustable speed control of the drive motor. Total enclosure prevents dust from escaping; accuracy of feed is not disturbed by moisture in the room.

FAN

The KVS Fan is substantially built. It has a heavy housing for carrying the KVS Herculite steel liners, heavy shafts, heavy bearings and heavy supports. The casing is constructed of steel plate; the scroll is fitted with liners of KVS Herculite steel to resist abrasion. Blade-supporting arms and spider are stronger; the weight of the fan and its utility are several times that of the average fan.

PULVERIZER

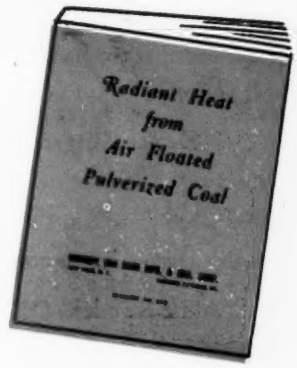
The KVS Air Swept Tube Mill, a *slow speed* ball mill, prepares all grades of coal for combustion at a low power cost and low maintenance cost. The pulverizing balls are carried by centrifugal force to a point where they are thrown down on the coal in a continuous cascade of balls delivering thousands of blows per second. The Air Swept Tube Mill has no mechanical discharge. The KVS variable speed fan *draws* air through the mill to the discharge, floating out an impalpable powder to deliver a carbureted fuel to the burners.

COAL BURNERS

KVS rotary and vortex Burners complete the cycle of coal preparation. They are engineered for low maintenance and high availability. Fed by a reliable feeder, pulverized to superfineness and delivered by an equally reliable fan, the coal, now a highly combustible mixture of carbon and oxygen, is given high turbulence in the burner. Complete carburization occurs before ignition.

AIR PREHEATERS, WATERWALLS, BOILERS AND SUPERHEATERS

KVS engineering is not committed to any single design in the generation of steam at low cost. There are standard KVS designs in the range from 25,000 to 200,000 pounds of water evaporated per hour, from saturated temperatures to 1,000°F. at the superheater outlet. Furnace volume, area and arrangement of heating surface, the generation of superheat and its control are fitted to each plant.



KVS ENGINEERING SERVICE

KVS Steam Generating Equipment has been performance proved over the years. KVS offers a complete service in design, building and erecting complete plants under one responsibility. KVS engineers are available for consultation on your requirements.

Ask for a copy of 97-page Engineering Bulletin No. 44-B containing valuable information on preparation of pulverized fuel and steam generating plants.

KENNEDY-VAN SAUN · QUALITY · SERVICE · Kennedy Products · NEW YORK · USA · MFG. & ENG. CORP.

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Can you hang this sign on your turbines?

Could the oil in your turbines today be left there for the next 10 or 15 or 20 years without removal for treating, resting, or cleaning the oil system? Yes, if it were Nonpareil Turbine Oil. For instance, take Nonpareil's operating record in the midwest utility plant shown at right.

Nonpareil was put into three 5,000 KW General Electric turbines in July 1932, November 1934, and November 1940, respectively. The first fills of Nonpareil have never been removed from the three turbines. In 16 years' operation in one unit, Nonpareil maintained an average neutralization number of .06 mg. KOH/gm. Because of low-acidity operation, there has been no need for treating oil or cleaning turbine oil systems.

Why risk dangerous acidity increase that can lead to the formation of harmful deposits and emulsions in turbine oil? Make your next fill Nonpareil Turbine Oil. It contains anti-corrosion and anti-foaming agents further to assure safe operation for the "life of your turbine."

Ask a Standard Oil Lubrication Engineer about the benefits of the written guarantee you receive with Nonpareil. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD

STANDARD OIL COMPANY (INDIANA)

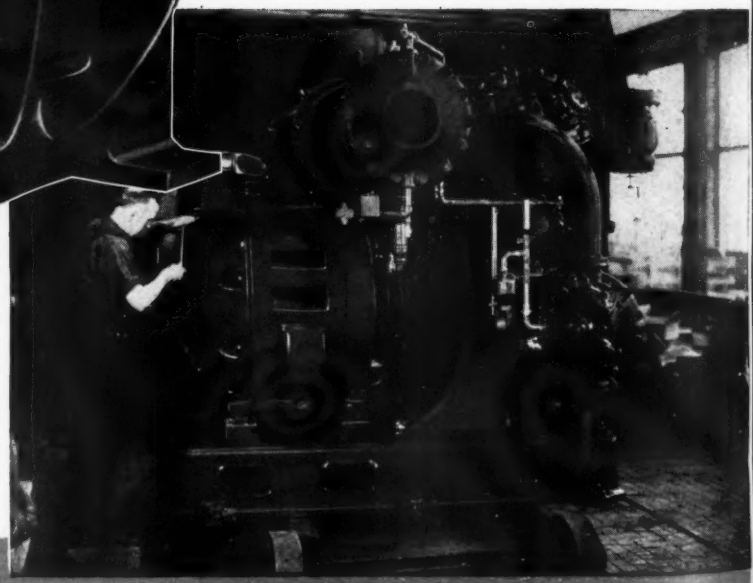
STANDARD OIL COMPANY (INDIANA)

STANDARD

they're here... they're

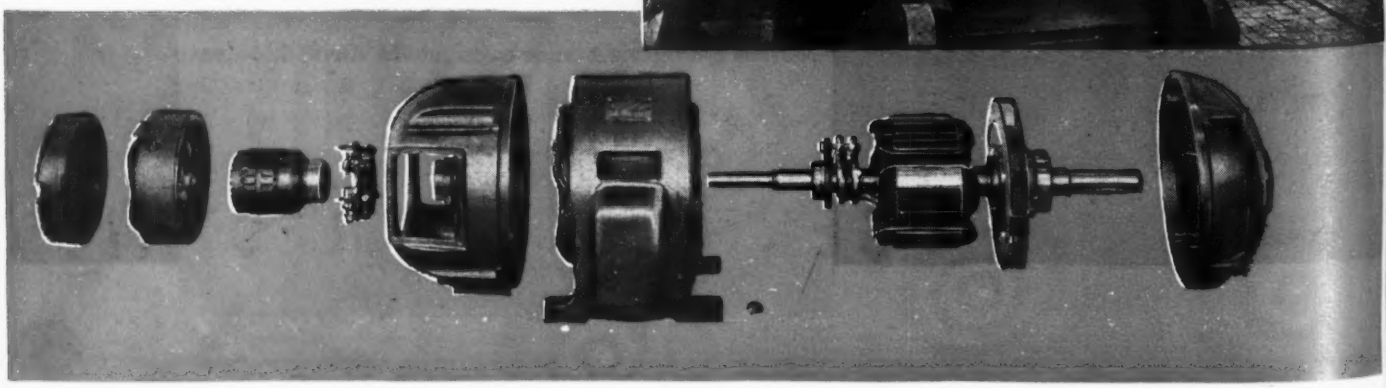
NEW HIGH

A new TRI-CLAD Synchronous Motor typical of those machines rated at about 500 hp at 720 rpm.



A new TRI-CLAD High Speed Synchronous Motor, rated 250 hp at 600 rpm, direct coupled to an air compressor.

Exploded view of G-E TRI-CLAD machine.



TRI-CLAD

REG. U.S. PAT. OFF.

SPEED SYNCHRONOUS MOTORS AND GENERATORS

These new synchronous motors and generators bring you the famous TRI-CLAD improvements:

Extra Protection Features!—against physical damage—against electrical breakdown—against operating wear and tear.

New Styling!—smooth, rounded contours—baffled ventilating louvers—smooth-corners on exciters and conduit boxes.

Following General Electric design leadership, the new line of Tri-Clad synchronous motors and generators give you the same design features that made Tri-Clad motors so successful in more than a million and a half industrial applications.

Tri-Clad construction gives you protection where it counts. Frames and end shields with no openings above the center line—give protection against dripping liquids, falling objects, and accidental blows.

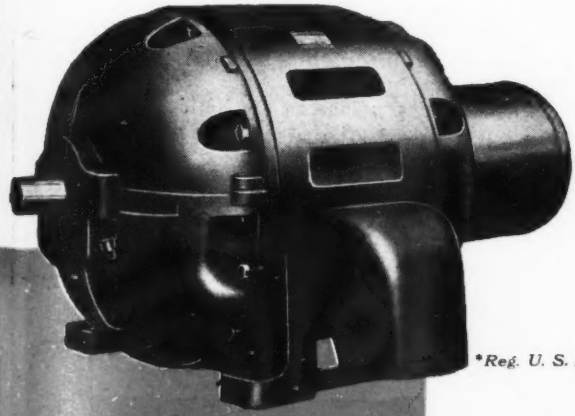
You get protection against electrical breakdown in normal operations. Proved insulating materials of the highest quality are used throughout. Small sizes (through frame 945) use Formex* wire for low voltage windings. Larger size coils are form wound and molded accurately to slot size.

Bearings are completely enclosed in cast iron with close running fits for long life with minimum maintenance. Deep oil reservoirs insure adequate lubrication with clean, cool oil.

You can get synchronous motors in the new Tri-Clad design in ratings from 20 hp to 1000 hp at 60 cycles, speeds from 514 to 1800 rpm. Synchronous generators are available from 12½ to 1250 kva. Direct connected exciters are available for any rating.

About ten years ago, the Tri-Clad design was introduced to combine the important features demanded by industry. Since then, it has been further improved with additional refinements—all of which have been incorporated in this new line of synchronous motors and generators.

For more information on how you will benefit from Tri-Clad construction in your synchronous motor and generator installations, contact your nearest G-E sales engineer. For detailed construction features, write for GEA-5113 (Motors) or GEA-5125 (Generators). *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

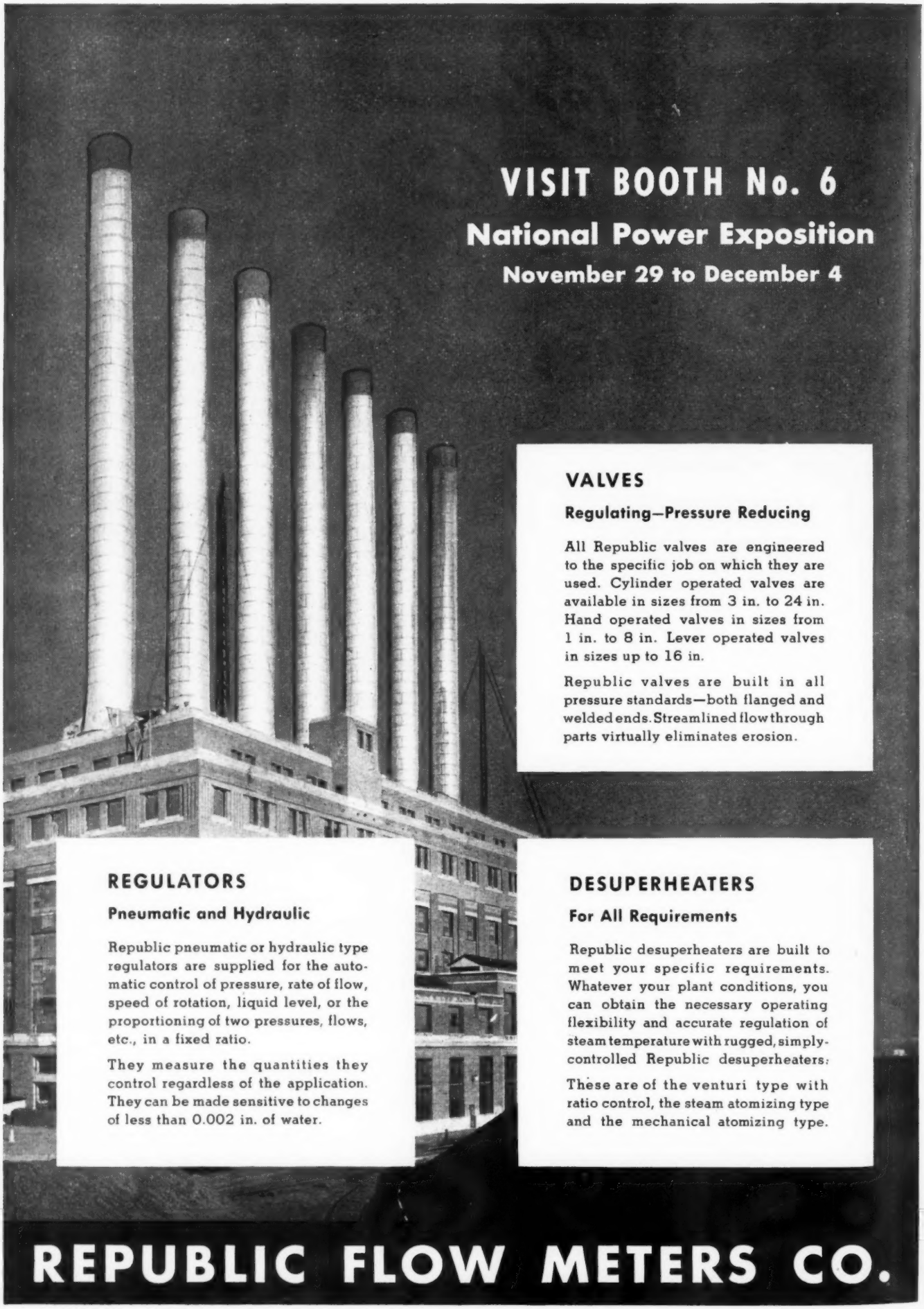


*Reg. U. S. Pat. Off.

Typical TRI-CLAD High Speed Generator with direct-connected exciter.

GENERAL ELECTRIC

770-1



VISIT BOOTH No. 6

National Power Exposition

November 29 to December 4

VALVES

Regulating—Pressure Reducing

All Republic valves are engineered to the specific job on which they are used. Cylinder operated valves are available in sizes from 3 in. to 24 in. Hand operated valves in sizes from 1 in. to 8 in. Lever operated valves in sizes up to 16 in.

Republic valves are built in all pressure standards—both flanged and welded ends. Streamlined flow through parts virtually eliminates erosion.

REGULATORS

Pneumatic and Hydraulic

Republic pneumatic or hydraulic type regulators are supplied for the automatic control of pressure, rate of flow, speed of rotation, liquid level, or the proportioning of two pressures, flows, etc., in a fixed ratio.

They measure the quantities they control regardless of the application. They can be made sensitive to changes of less than 0.002 in. of water.

DESUPERHEATERS

For All Requirements

Republic desuperheaters are built to meet your specific requirements. Whatever your plant conditions, you can obtain the necessary operating flexibility and accurate regulation of steam temperature with rugged, simply-controlled Republic desuperheaters.

These are of the venturi type with ratio control, the steam atomizing type and the mechanical atomizing type.

REPUBLIC FLOW METERS CO.

BOILER CONTROLS • INSTRUMENTS • PROCESS CONTROLS

The Republic Flow Meters Co. offers a complete manufacturing and engineering service in the field of measurement and control. We will be glad to co-operate with you in the solution of any metering or control problem, whether it involves a single instrument or the automatic control of an entire process or plant.

Republic engineers, in co-operation with your own engineers, will be glad to study your problem and make recommendations as to the most practical solution. Your inquiries will involve no obligation on your part.

BOILER CONTROLS

For All Types of Boilers

Republic offers a centralized, automatic system for controlling steam pressure, combustion, furnace pressure, excess pressure, boiler water level, etc.

Automatically regulates the fuel and air imput to a boiler in measured proportions and in a fixed ratio for the entire load range. Available for all sizes of boilers and all types of fuel firing.

FLOW METERS

Electrical and Mechanical

Republic electrical type remote reading flow meters are available for measuring the flow of all types of liquids and gases. Meter bodies are built for line pressures up to 10,000 p. s. i. and for all ranges of differential pressures.

Mechanical ring-balance meters are built for static pressures up to 2500 p.s.i. and to operate on differentials as low as 3 in. of water.

BOILER METERS

Record Steam Flow—Air Flow

The Republic boiler meter records simultaneously on one chart the steam flow from the boiler and the rate of air flow to the furnace for combustion.

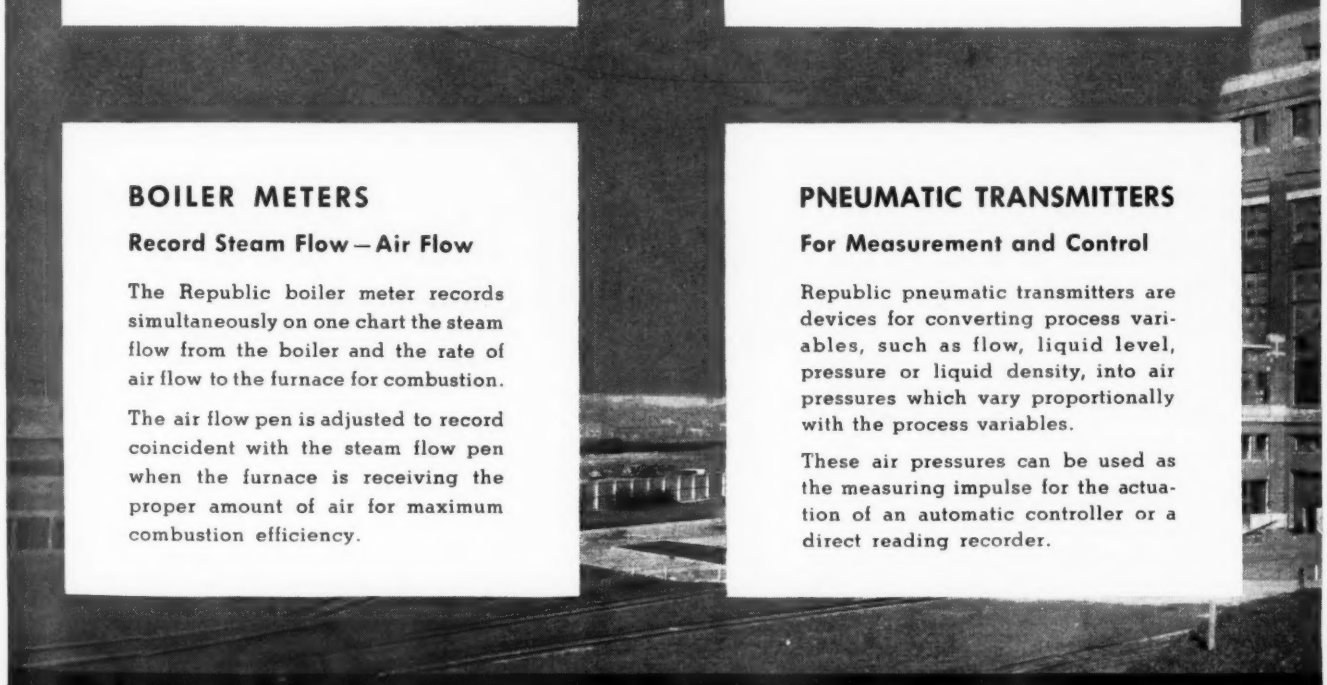
The air flow pen is adjusted to record coincident with the steam flow pen when the furnace is receiving the proper amount of air for maximum combustion efficiency.

PNEUMATIC TRANSMITTERS

For Measurement and Control

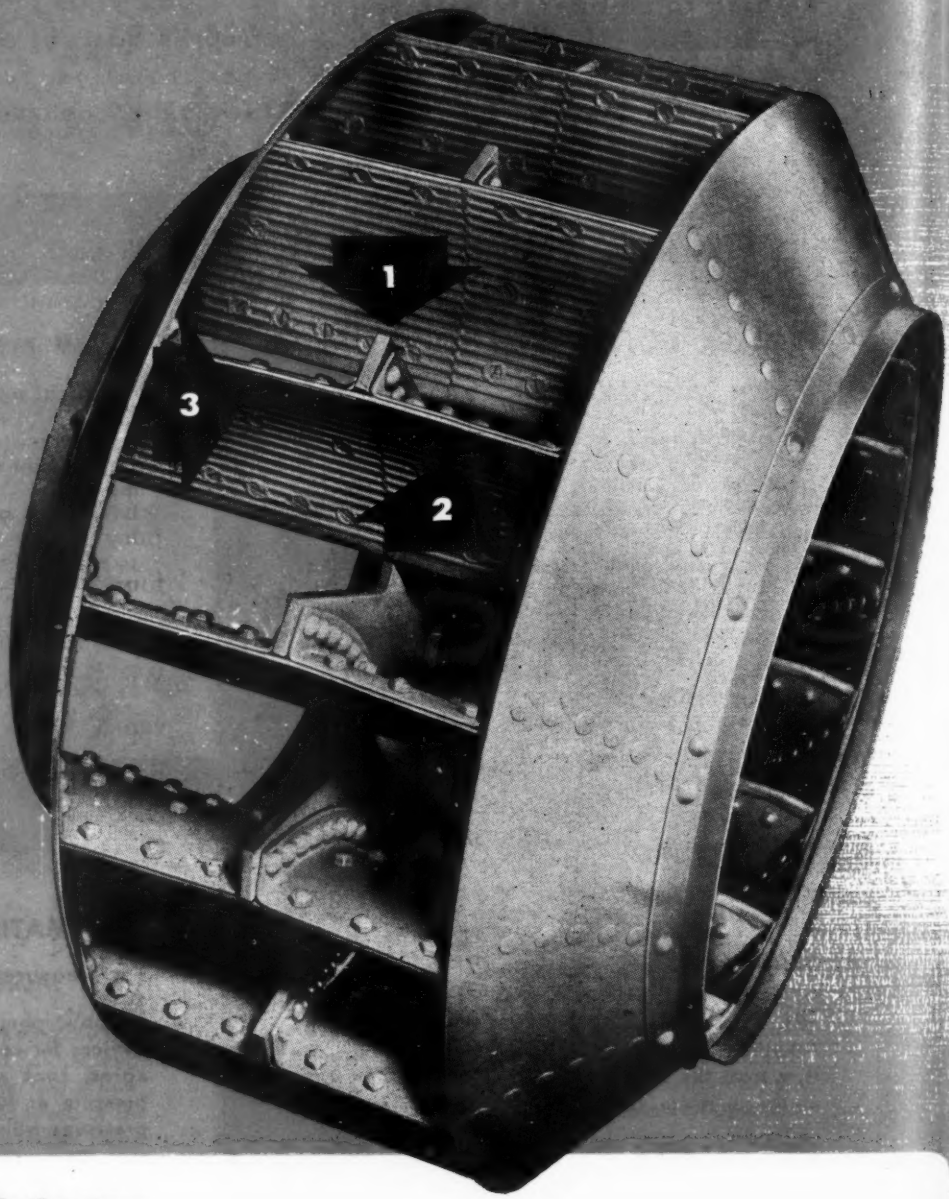
Republic pneumatic transmitters are devices for converting process variables, such as flow, liquid level, pressure or liquid density, into air pressures which vary proportionally with the process variables.

These air pressures can be used as the measuring impulse for the actuation of an automatic controller or a direct reading recorder.



2240 Diversey Pkwy., Chicago 47, Illinois

THE E-R* WHEEL



This picture tells the story

1. Center support is cut away between the fan and the blades, permitting streams of concentrated fly-ash to meet—and dissipate their abrasive action on each other instead of on the wheel surfaces.

2. Continuous blades offer no obstruction to the smooth flow of fly-ash. Center plates and tie rods are eliminated. Each wheel has only 32 blades, shaped to minimize abrasive action.

3. Where fly-ash travel is greatest, special ribbed liners protect the wheel blades. These liners, easily and quickly renewable, prolong wheel life, save maintenance time and labor, and minimize outage losses.

IS THE REASON

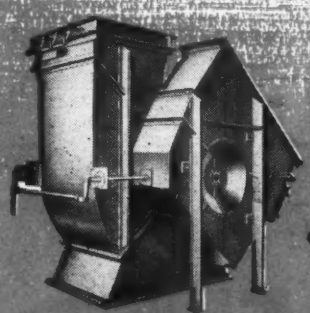
WHY STURTEVANT TVID FANS GIVE 2 TO 4 TIMES LONGER LIFE

It used to be that abrasion resistance of an induced draft fan wheel was unimportant. Low pressures and low tip speeds meant a low rate of wear. Today, because of higher tip speeds and higher pressures, abrasion resistance is as vital a factor in fan design as capacity or efficiency. Actually it is even more important to the operator who has to shut down his induced draft fan for a costly time-consuming job of reblading.

The E-R* (erosion resistant) wheel is the Westinghouse solution to this problem. Note in the illustration at the left how this design minimizes erosive action of the fly-ash; how it minimizes shut-down time because only the blade liners need be renewed. Results? Well, many years of service, in numerous installations, prove conclusively that it gives two to four times longer life, lower maintenance, and higher efficiency. For more information write: Westinghouse Electric Corporation, Sturtevant Division, 27 Readville Ave., Hyde Park, Boston 36, Mass.

Westinghouse

Sturtevant Division

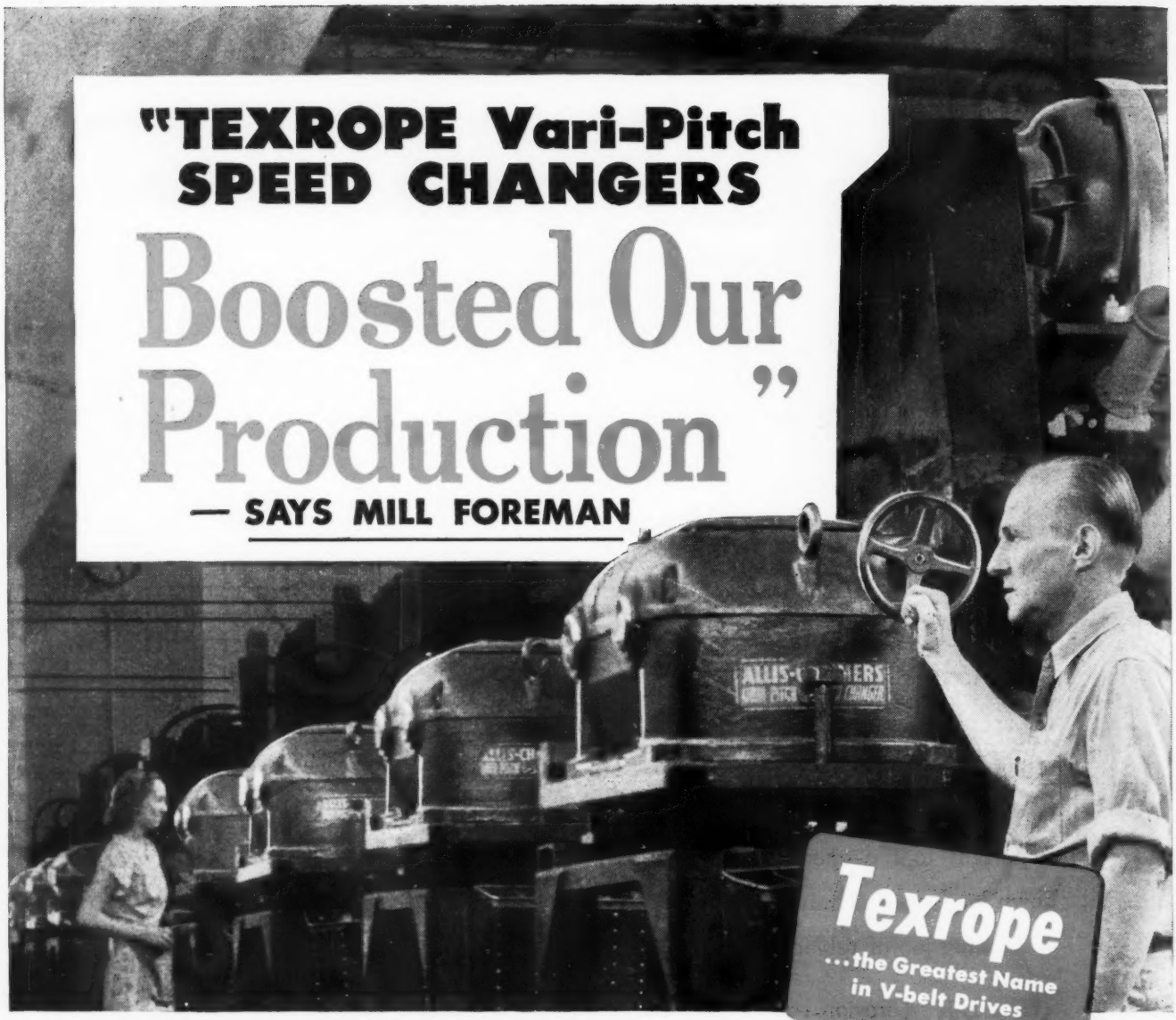


This Book May Save You Money

Here's a booklet that contains a wealth of helpful information about mechanical draft equipment. Some of the data in it might very possibly be just what you need. For your copy, ask for Bulletin B-3801.

Sturtevant Turbovane Induced-Draft Fan

B-8004B



"With these clean, compact units, we can change speeds without stopping ...get in-between speeds we need."

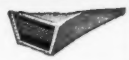
FOR GREATER MACHINE OUTPUT in *your* plant, get the same variable speed drive that makes mill foreman Ralph Finkboner of Rochelle, Illinois, so enthusiastic. Texrope Vari-Pitch Speed Changers give you smooth, accurate speed control at the turn of a crank. You operate your machines at *exactly* the right speed for highest production.

V-belt drive cushions Texrope Vari-Pitch Speed Changers against shock loads. Design is simple, compact, smooth running and easy to keep clean. Capacities range from 1 to 75 HP with stepless speeds up to 3.75 to 1.

Texrope Authorized Dealers and Allis-Chalmers District Offices have at their command the greatest V-belt experience in the industry. Consult them and be *sure* of the best drive for your particular need. Listed in SWEET'S, A 2541

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.

Texrope, Super-7, Texsteel, Texdrive, Magic-Grip and Vari-Pitch are Allis-Chalmers trademarks

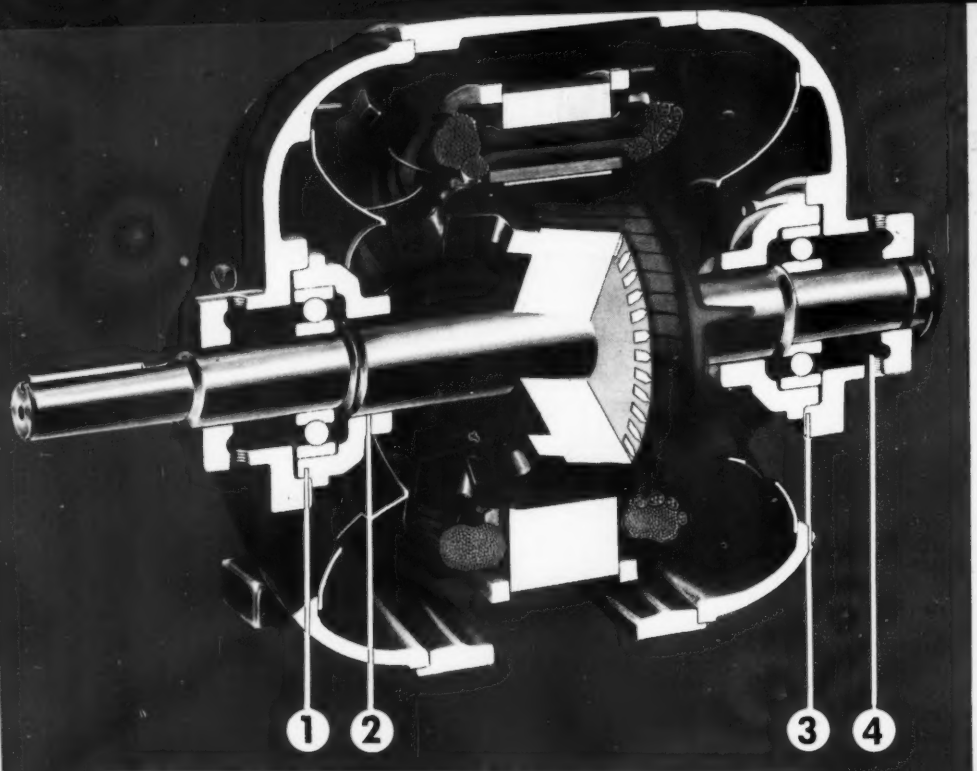
A Complete Range of Products		
Super-7 V-belts	5 types . . . sizes to suit every power transmission job	
Texsteel, Texdrive, Magic-Grip	Sheaves in a full range of sizes and grooves	
Vari-Pitch Sheaves	Exact variations in speed — Stationary or Motion control	
Speed Changers	Speed variations up to 375% at the turn of a crank	

Texrope Super-7 V-belts result from the cooperative research of Allis-Chalmers and B. F. Goodrich; and are sold only by A-C dealers and offices.

ALLIS-CHALMERS

Originators of the Multiple V-belt Drive for Industry

YOU CAN'T BEAT A
TRI CLAD MOTOR FOR
EASY MAINTENANCE
GENERAL ELECTRIC
HERE'
WHY



Notice (1) how Tri-Clad bearings are surrounded by and rigidly supported in solid cast-iron housings. Compare the long, close-running fit between housing and shaft (2) with other motor bearings. Examine the tight rabbet fit between inner cap and end shield (3) which keeps dust and moisture out and lubricant in. See, too, the pressure-relief greasing system (4) that makes it easy to lubricate if you need to.

You can't beat a TRI CLAD motor for easy maintenance

A TRI-CLAD MOTOR will run safely without lubrication for years—for as long as any other general-purpose motor you can buy. The big thing is—it's *grease-gun easy* to lubricate a Tri-Clad if you need to.

You don't have to take a Tri-Clad motor down and disassemble the bearings to lubricate it. You don't have to follow special instructions. A standard gun and a good grease are all you need.

And remember, Tri-Clad gives you all the extra protection that only cast-iron structure can give . . . Extra protection against rust and corrosion . . . Extra protection against mechanical abuse and permanent distortion . . .

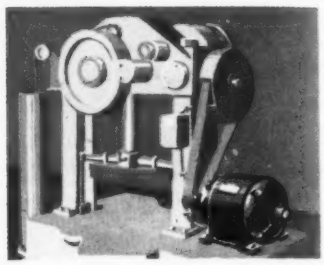
Extra protection that has been proved in more than 5 billion hours of rough-and-tumble industrial service.

WANT TO SEE FOR YOURSELF? Tri-Clad motors in nearly all types and ratings are ready for **IMMEDIATE SHIPMENT.** Contact your nearest G-E Office or write *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

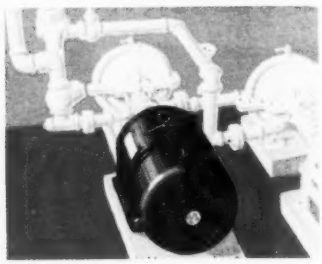
GENERAL ELECTRIC

760-8

There's a Tri-Clad motor for every industrial need!

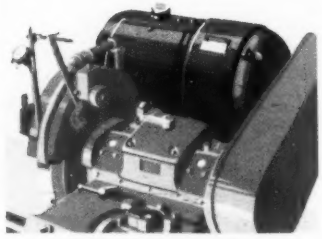


G-E open (dripproof) induction motors for constant-load, constant-speed applications. From 1 to 2000 hp.



G-E totally enclosed motors for operation where dust or corrosive fumes are a hazard. From 1 to 1000 hp.

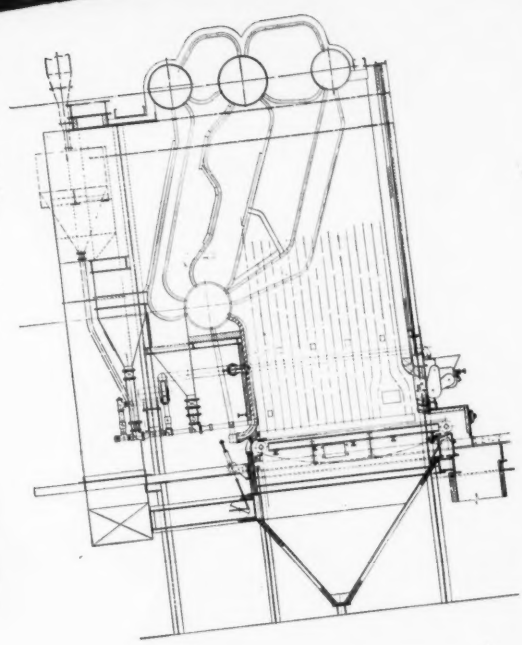
G-E capacitor motors for use on fans, blowers, pumps and compressors with single-phase power. From ¾ to 5 hp.



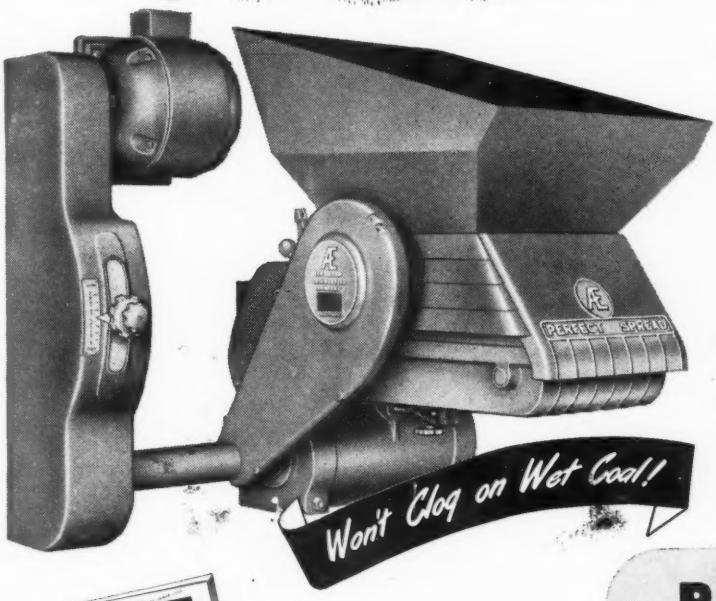
G-E Type ACA induction motors for adjustable speeds—provide 3 to 1 speed range. From 3 to 200 hp.

YOU CAN'T BEAT TRI CLAD EXTRA PROTECTION

Maximum Combustion Efficiency at MINIMUM COST



● *This installation at the Eastern plant of a national rubber company consists of an Æ Perfect Spread Stoker with Continuous Ash Discharge, with 183 sq. ft. grate area. Installed under a Babcock & Wilcox boiler with 6900 sq. ft. of heating surface, this unit is equipped with an air heater for 300° air temperature. Designed to handle increased requirements of the plant, this stoker is capable of delivering 60,000 lbs. per hour steam output using lower grades of strip coal . . . an important economy which will result in savings year after year.*



With the Æ Perfect Spread Stoker you're able to burn a wide variety of fuels—even the cheaper or lower grades of coal—and be assured of highly efficient, consistently thorough combustion.

Whether you're now hand-firing your boilers or want to replace old, inefficient equipment you'll appreciate the exclusive Æ advantages that mean completely dependable steam generation at low operating cost. Take the Continuous Ash Discharge feature for example . . . this traveling grate system provides entirely automatic removal of ash, eliminates periodic dumping of grates and cleaning of fires thus maintaining top efficiency at all times. Then too, this compact, economical stoker operates smoothly, perfectly even on wet, damp or partially frozen coal—without clogging.

Find new freedom from fuel worries and maintenance problems with an Æ Perfect Spread Stoker in *your* boiler room. Write for descriptive booklet today!

FREE—

Get this informative booklet on the Æ Perfect Spread Stoker today. Write Dept. 24.

PERFECT SPREAD

Æ STOKER

With Traveling, Dumping or Stationary Grates

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AMERICAN ENGINEERING COMPANY

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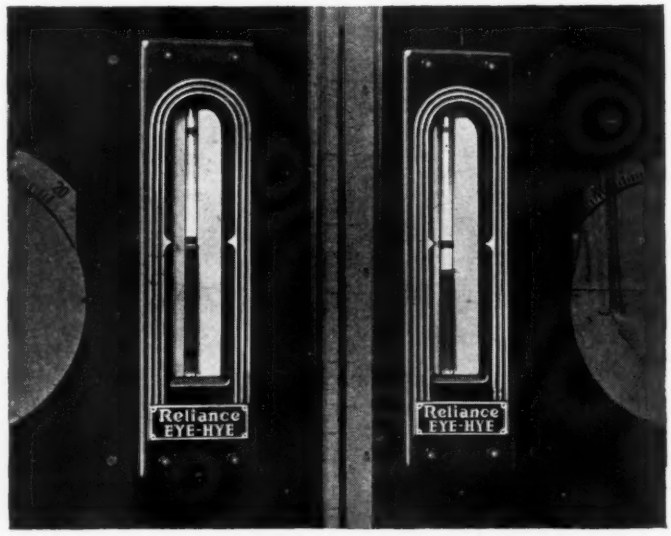
OTHER Æ PRODUCTS—Taylor Stokers—Lo-Hed Electric Hoists & Car Pullers—Hele-Shaw Fluid Power—Marine Deck Auxiliaries

Watch EYE-HYE'S® Green Fluid

EYE-HYE is a duplicate gage (remote reading) that's usually more accurate than the gage at the drum. It *reads like* the usual gage—carries the same type of image to your instrument panel or to an *eye-level* position near the boiler. Its green indicating fluid is illuminated . . . stands out strikingly clear among other instruments and controls . . . a familiar sight in thousands of power plants.

SIMPLICITY is the secret of EYE-HYE's dependable full-range accuracy—all hydrostatic operation, no mechanical working parts. Factory-calibrated to your water level range and working steam pressure—nothing to adjust during installation; cannot be tampered with. Easy to install, practically no maintenance.

Various EYE-HYE models fit any remote gage need—boilers, tanks, storage vessels—any pressure. More than 8000 EYE-HYEs in use, on land and sea. Write the factory or your nearest Reliance Representative for more details.

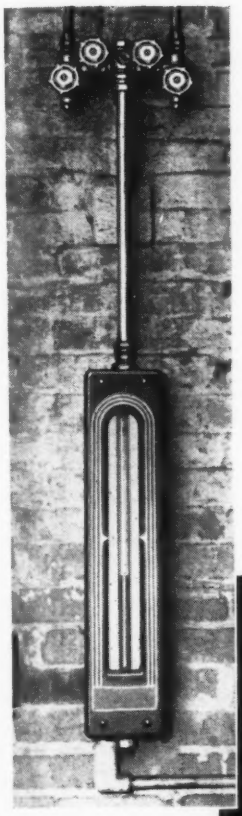


BOILER SAFETY DEVICES since 1884

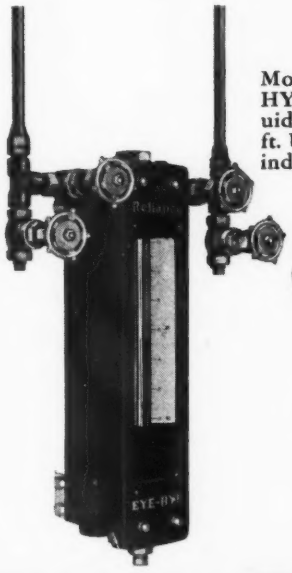
® Reliance

THE RELIANCE GAUGE COLUMN CO. · 5902 CARNEGIE AVENUE · CLEVELAND 3, OHIO

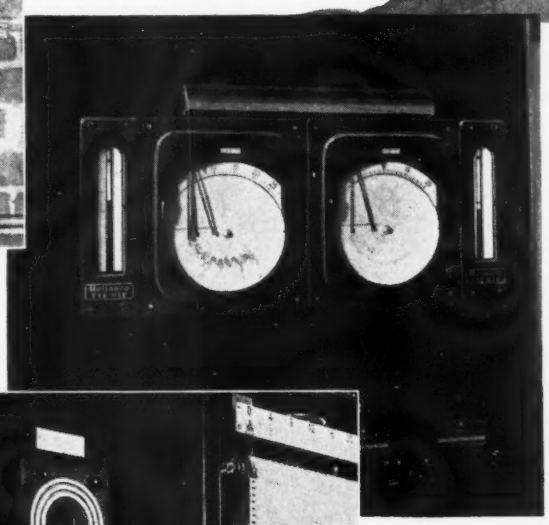
for *accurate, dependable* reading of your vital boiler water levels

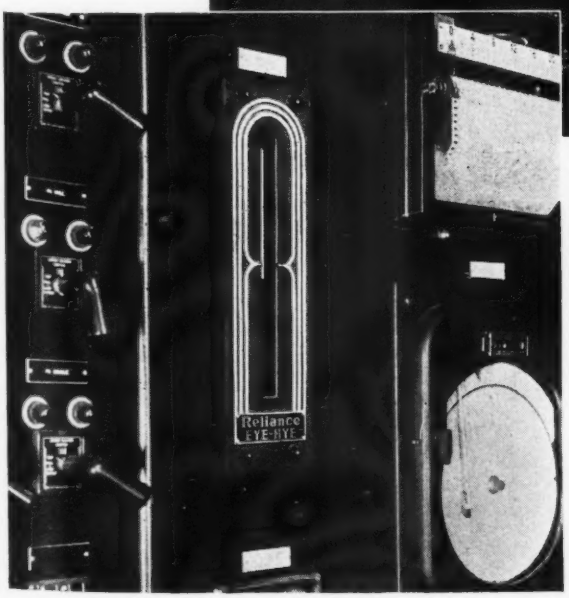


Model E-32L, for liquid levels up to 4 ft. variation.



Model E-21 EYE-HYE measures liquid levels up to 12 ft. Uses mercury as indicating fluid.

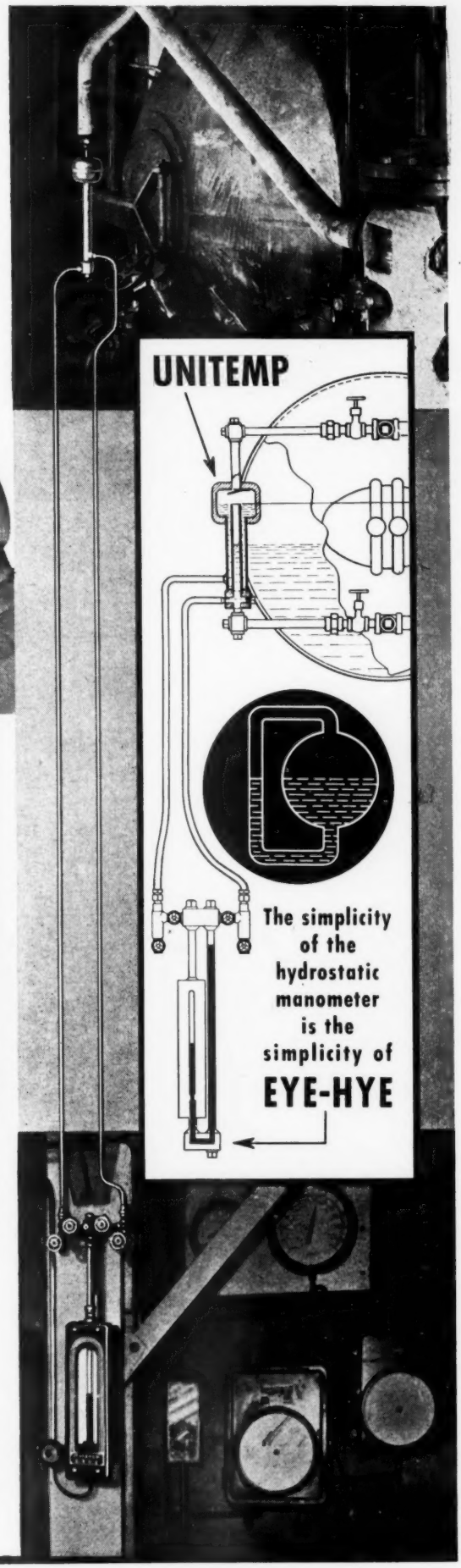




Two Model E-33 EYE-HYEs . . . panel-mounted . . . for pressures to 400 lbs.

★

Panel-mounted Model E-31, used on pressures to 900 lbs. (Model E-35 for pressures to 2000 lbs.)



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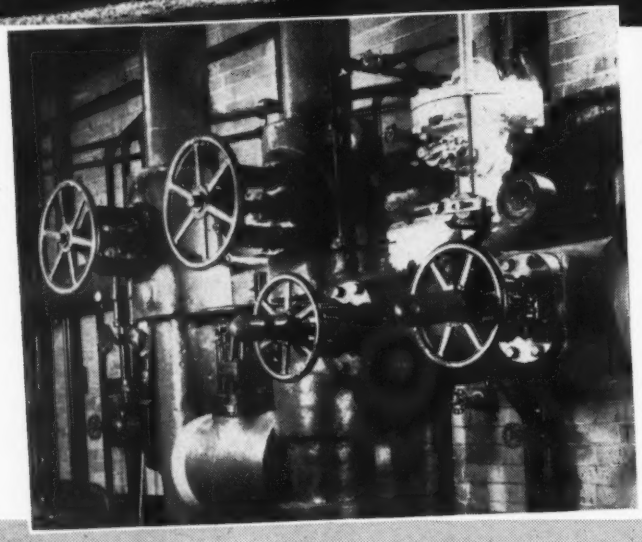
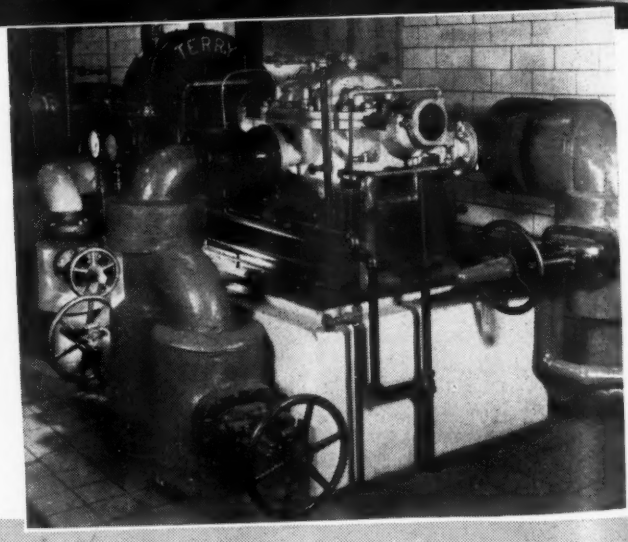
ARCHITECTS AND ENGINEERS
SCHMIDT, GARDEN & ERICKSON
CHICAGO, ILLINOIS





More power to Industry

includes **LUNKENHEIMER VALVES**

...at INGALLS-SHEPARD DIVISION WYMAN-GORDON CO. Harvey, Illinois

Housed in a strikingly modern, all-reinforced concrete, windowless building, the power plant of this manufacturer's forge shop is a picture of modern efficiency. The list of principal suppliers reads almost like "Who's Who" of power house equipment manufacturers.

Among these big names is that of LUNKENHEIMER . . . identifying high and low pressure valves that serve in multiple installations on lines and equipment.

The 85-year old LUNKENHEIMER reputation back of a widely varied line of quality valves has gained the confidence of planning and operating men alike. That's the reason LUNKENHEIMER VALVES are so often specified for modern installations . . . for long life, minimum maintenance and true, low-cost service.

Lunkenheimer Valves are available through Distributors in all industrial centers.

ESTABLISHED 1862

THE LUNKENHEIMER CO.

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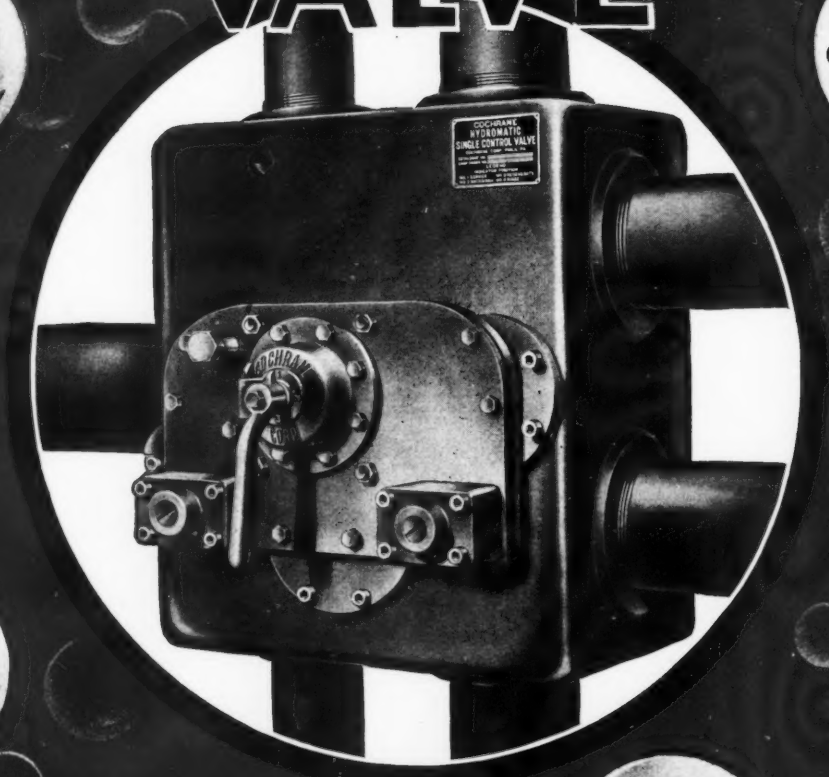
Zeolite Systems & Pressure Filters

featuring the

HYDROMATIC SINGLE CONTROL VALVE

FOUR-POSITION *for* FLEXIBILITY

INTEGRAL RATE CONTROLS *for* COMPACTNESS



PILOT ACTUATED *for* SMOOTH OPERATION

FLEXIBLE BELLOWS VALVE *for* FRICTION FREE OPERATION

TIGHT SEATING *for* RELIABLE SERVICE

SLOW MOTION *for* SHOCK-PROOF OPERATION

BUILT-IN RATE CONTROLLERS *for* WASH AND RINSE

COCHRANE HYDROMATIC SINGLE CONTROL VALVE

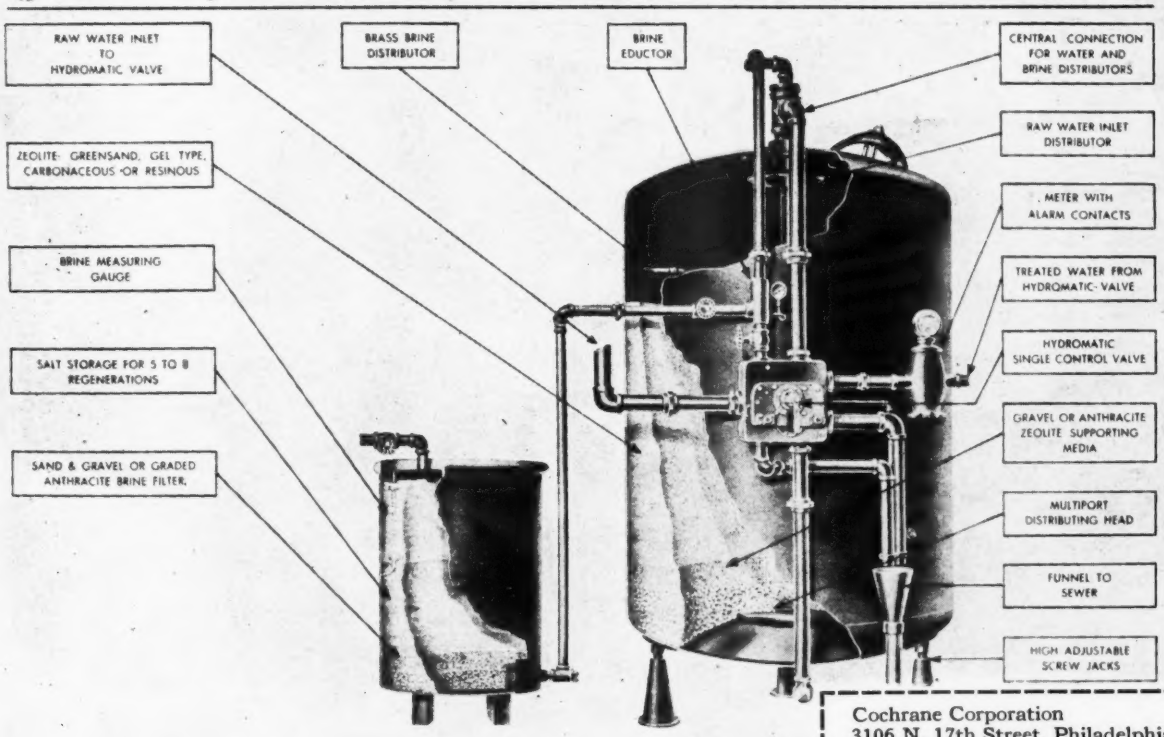
THE VALVE THAT MAKES ORDINARY ZEOLITE SOFTENER AND FILTER EQUIPMENT OUT-MODED

THE introduction by the Cochrane Corporation of a remarkable single control valve as standard equipment on its well-known Zeolite Softeners and on its Pressure Filters makes the operation of the ordinary softener and filter system seem far out-moded. This Cochrane Hydromatic Single Control Valve speeds operations and insures accuracy of operation by integrating the functions of the usual valve nest in one single valve with four normal operating positions and two standby positions. All actions of the valve are smooth, positive and free from shock and the single lever turns with ease. Power is provided by the raw water itself through a pilot valve.

May be arranged for manual or automatic operation

COCHRANE CORPORATION • PHILADELPHIA 32, PA.

Cochrane Zeolite Water Softener with Hydromatic Single Control Valve


RAW WATER INLET TO HYDROMATIC VALVE
BRASS BRINE DISTRIBUTOR
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RAW WATER INLET DISTRIBUTOR
ZEOLITE: GREENSAND, GEL TYPE, CARBONACEOUS OR RESINOUS
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TREATED WATER FROM HYDROMATIC VALVE
HYDROMATIC SINGLE CONTROL VALVE
SALT STORAGE FOR 5 TO 8 REGENERATIONS
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The story of Cochrane Hydromatic Valves is told in Publication 4460. A copy will be sent on request. Coupon is for your convenience.

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Please send us a copy of Publication 4460 describing Cochrane Hydromatic Valve.

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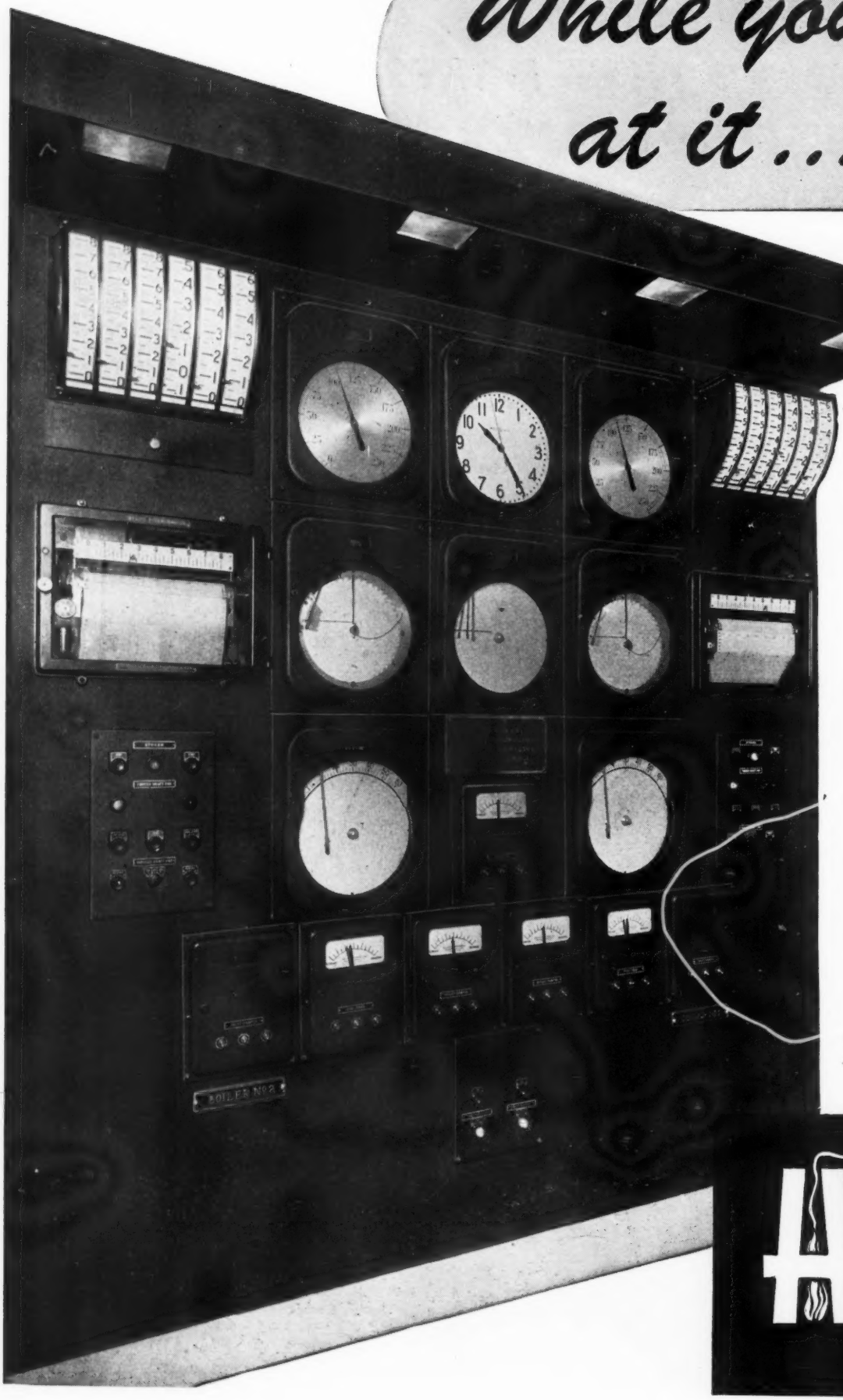
COCHRANE HYDROMATIC SINGLE

While you're at it...



HAYS
INDUSTRIAL
INSTRUMENTS

PUT IN THIS MODERN SYSTEM—

HAYS Automatic COMBUSTION CONTROL

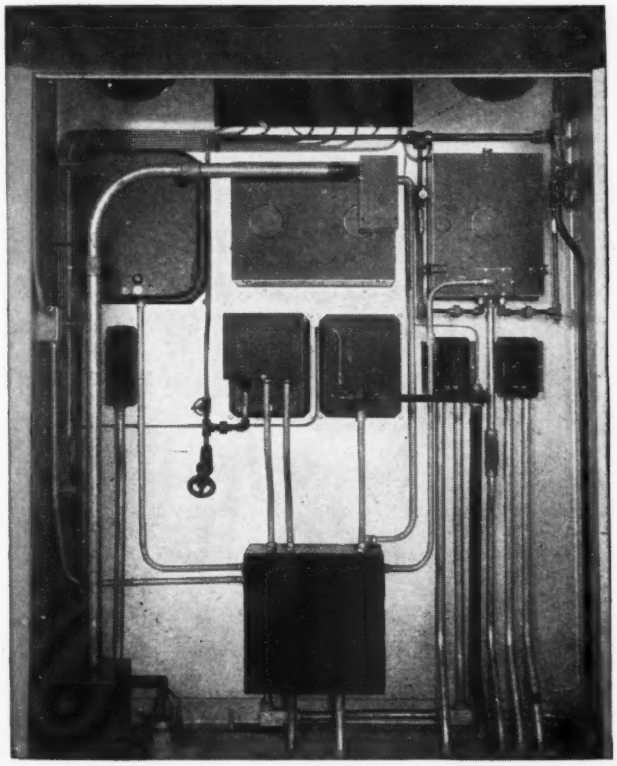
it's Electrical

ACCURATE, SIMPLE, DEPENDABLE, Hays centralized automatic combustion control is the truly modern method.

It is wholly electrical. Every combustion variable is measured accurately and corrected instantly. Sensitive contacts are operated by enclosed mercury switches—no possibility of moisture or dust; no sticking, chattering or excessive wear. Adjustments are made direct—no dependence on air pressures, oil pressures and intricate valve systems required in non-electrical designs. It is easy to install, easy to operate, easy to maintain.

For full details write for Bulletin 46-605—contains schematic drawings of 14 typical installations.

THE HAYS CORPORATION
Michigan City, Indiana



These six potent features tell a quick convincing story of Hays advantages:

1. **All Electric operation.**
2. **Simple, positive, modern.**
3. **Easy for operators to understand, operate, maintain.**
4. **For all sizes of steam generating systems burning *any kind of fuel*.**
5. **A thoroughly engineered installation by a Hays representative . . . Hays engineer representatives in all principal cities.**
6. **Every variable is accurately measured and proper corrections made *instantly*—electrically.**

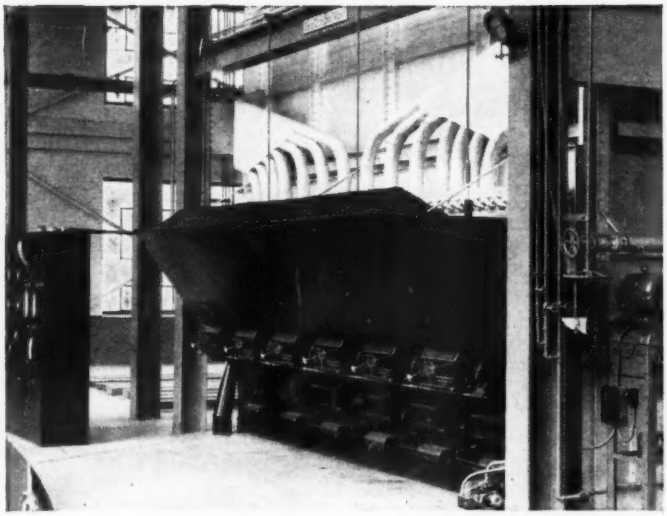
View is of panel from the rear with access doors open to show the workmanlike wiring and the accessibility of all instruments and controllers. This type of fine workmanship is standard with Hays.

Automatic **COMBUSTION CONTROL**

INDUSTRIAL CONTROL · FLOWMETERS · GAS ANALYZERS · DRAFT GAGES · CO_2 RECORDERS

Firite HOFFMAN

The HOFFMAN FIRITE is the original forced draft spreader type stoker . . . the pioneer of its kind . . . A product of 25 years of continuous refinement. Engineered for long life and low maintenance.



COAL FEEDING UNITS

FIRITE coal feeder units are of the mechanical spreader type using the underthrow principle, and a loose impeller mechanism consisting of a main impeller shaft with large dust-sealed water-cooled bearings; equipped with four concentric shafts on which are suspended—in series—loose impeller blades which are held in operating position by centrifugal force, and which provide ample clearance for tramp iron and other reasonably large refuse which may be in the fuel supply.

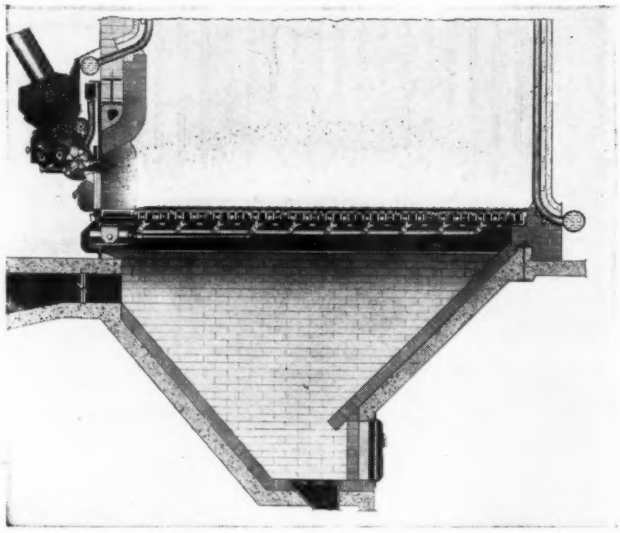
The impeller mechanism operates at low speed. All bearings are dust-sealed and of ample size. Interior wearing surfaces are equipped with patented replaceable liners.

The coal flows by gravity from the hopper to a reciprocating coal feeder plate, which delivers the coal to an adjustable tray having a machined curved face, from which the coal is picked up by the revolving impeller mechanism and delivered to the furnace, accomplishing a uniform spread over the entire grate area by means of the unique curvature of the impeller blades.

MANUAL ADJUSTMENTS—Quick manual adjustments are provided to maintain uniform spread over wide fluctuations in sizes and surface moisture conditions of the coal supply.

Dumping Grates, either power or manually operated will fit any furnace width, due to the flexible design.

In laying out a furnace arrangement, first determine the proper width of grates and then determine the length by increments of 15 inches to obtain suitable projected area for correct combustion rates.



HOFFMAN COMBUSTION

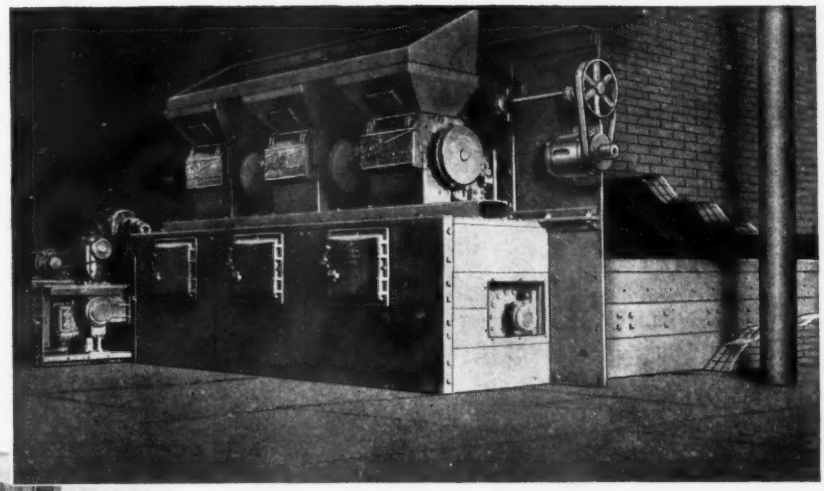
HOME OFFICE: DETROIT 26, MICHIGAN

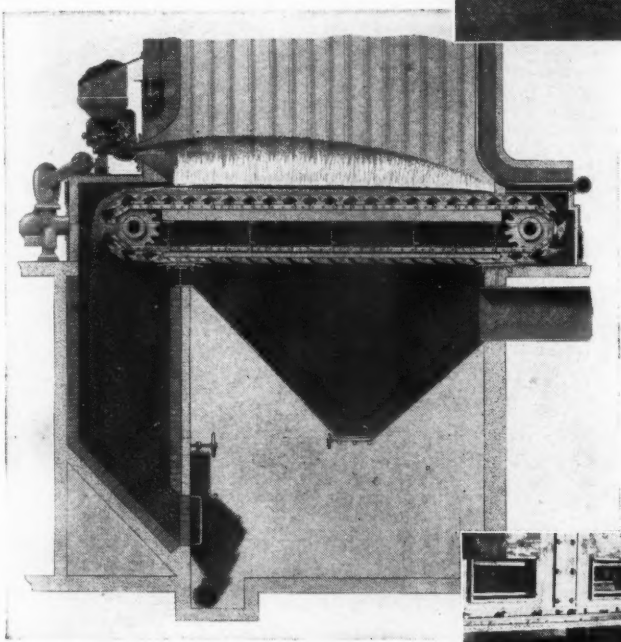
BRANCH OFFICES OR AGENTS IN PRINCIPAL CITIES

STOKERS

Firite

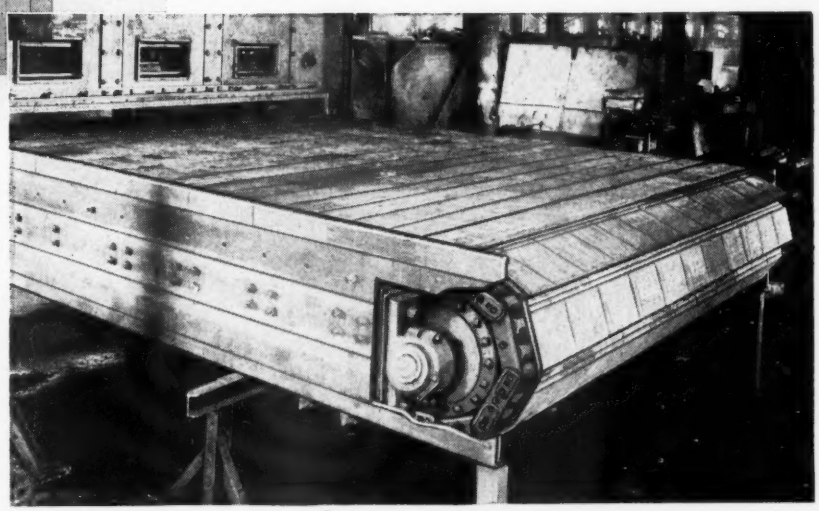
Hoffman Firite Spreader Type Stokers equipped with Hoffman Continuous Ash Discharge Grates, may be designed for either front or rear discharge to suit local plant conditions.





- **Expansion and permanent growth of grate structures due to furnace temperatures are absorbed in expansion joints, provided in the design.**
- **Any expansion in grate structure will not be transmitted to the moving carriage, due to the method of mounting.**
- **Grate and fuel bed load is not carried on chain and sprockets.**
- **Hoffman C-A-D grates may be installed to discharge at either front or rear.**

- **Unique air entry through the lower strand.**
- **Uniform air pressures under all parts of upper strand.**
- **Positive air seals, both front and rear . . . that work.**
- **Effective air seals between grate bar sections.**
- **Minimum heat conductivity from fuel bed to carriage.**

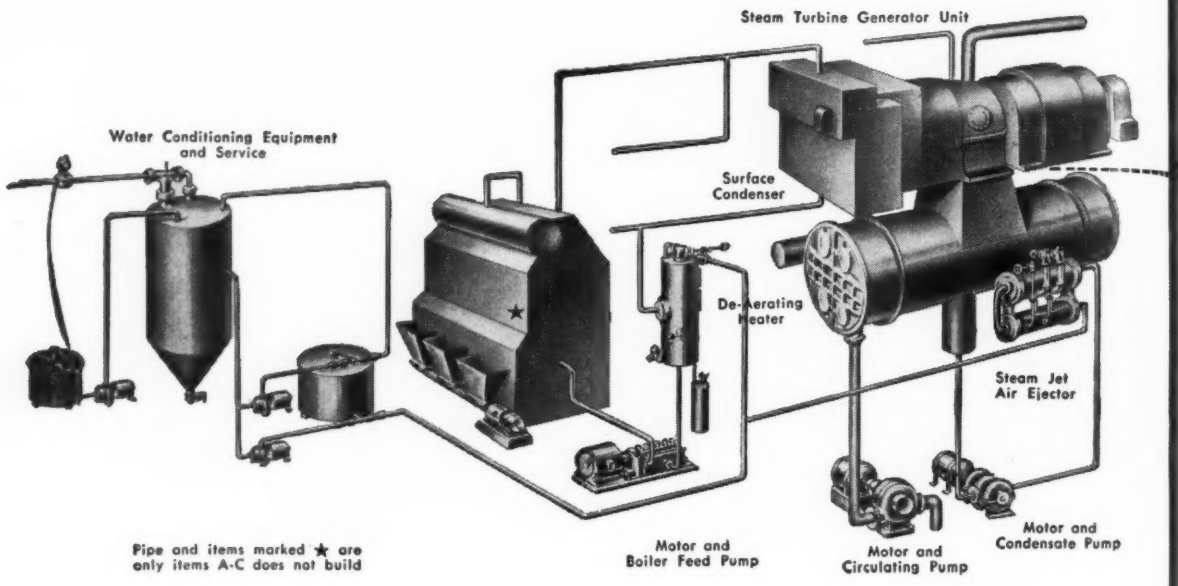


Ready to Ship

ENGINEERING COMPANY

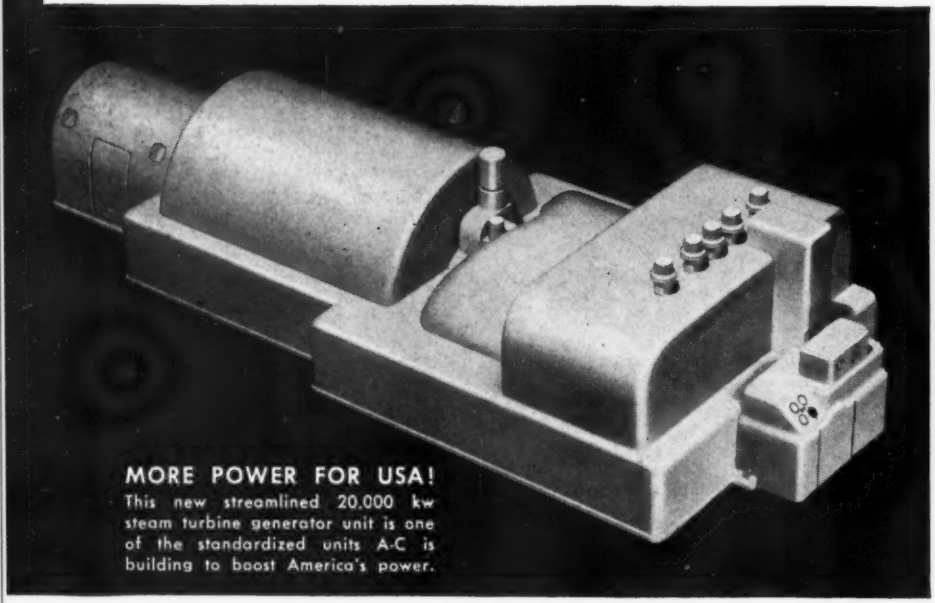
WORKS AT: FAIRMONT, WEST VIRGINIA
DETROIT, MICHIGAN

POWER "LINE-UP"


Steam Turbine Generator Unit
Water Conditioning Equipment and Service
Surface Condenser
De-Aerating Heater
Steam Jet Air Ejector
Pipe and items marked ★ are only items A-C does not build
Motor and Boiler Feed Pump
Motor and Circulating Pump
Motor and Condensate Pump

➡ Look to Allis-Chalmers for the Most Complete Line of Major Equipment for Power!

➡ Equipment Better Built, Advanced in Design!



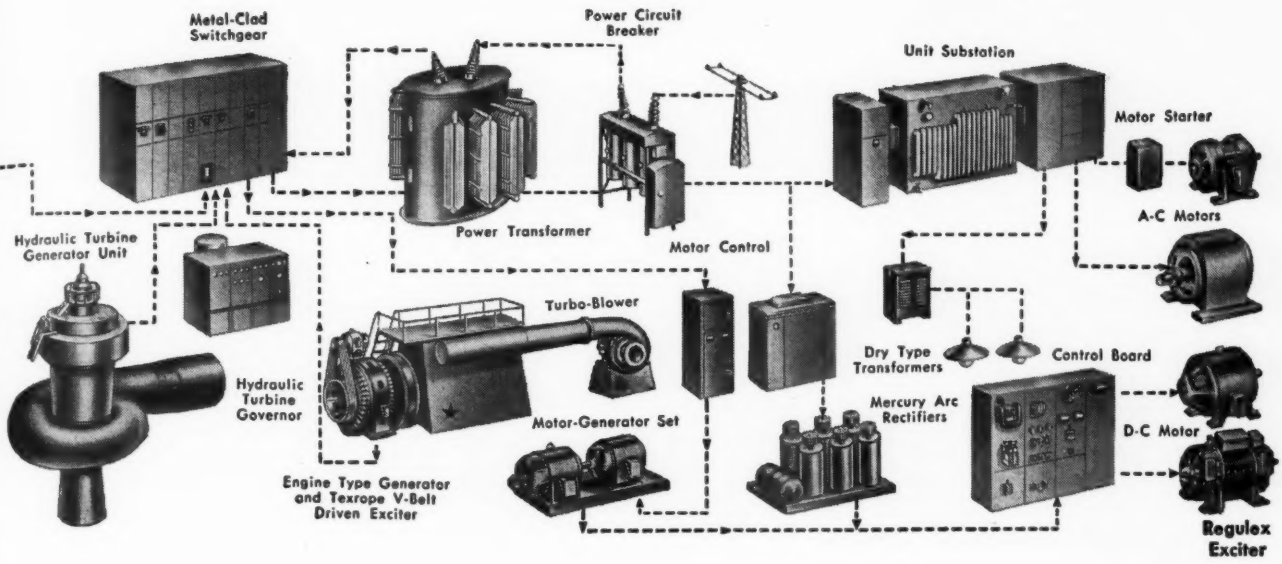
MORE POWER FOR USA!
This new streamlined 20,000 kw steam turbine generator unit is one of the standardized units A-C is building to boost America's power.

110,000 GPM!
Huge circulating pumps supply a never-failing supply of water to giant Allis-Chalmers condensers.

One of the Big 3 in Power Equipment—
Biggest of all in Range of Industrial Products

ALLIS

FOR '49 . . .



TO DATE, MILLIONS of dollars have been spent on improving and increasing our plant facilities. And many new production methods are going into use to build better products. Among the new and improved products being built are the advanced steam turbines pictured below.

As your '49 plans for *future* expansion crystalize, our engineers will be ready to meet your purchasing needs with both — modern, up-to-date equipment designs — and the experience gained in 100 years serving industry.

* * *

Allis-Chalmers has literally "grown up" with the Power Industry, and is still growing. Pioneering in generation, transmission, and utilization equipment, A-C has contributed many "firsts" to your industry. Yes, look again at the power "line-up" above — then, look to ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 2351

EVERYTHING FOR POWER!
A mammoth condenser together with a huge condenser circulating pump, two synchronous motors and a vertical condensate pump, are shown . . . all built by Allis-Chalmers.

"LINE-UP" FOR MORE POWER!
New 32 page bulletin, 25B6150A covers all A-C products for power. Send for your copy today.

CHALMERS

POWELL makes a valves designed

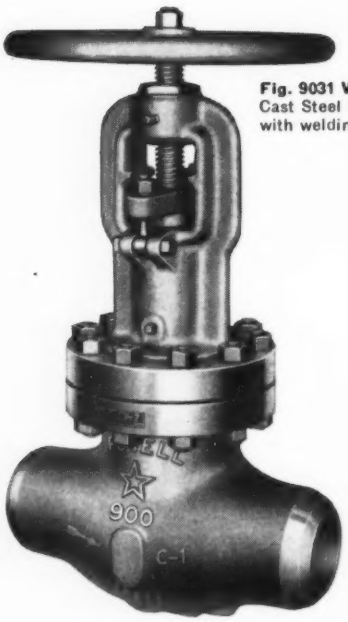


Fig. 9031 W. E.—Class 900-pound Cast Steel O. S. & Y. Globe Valve with welding ends.

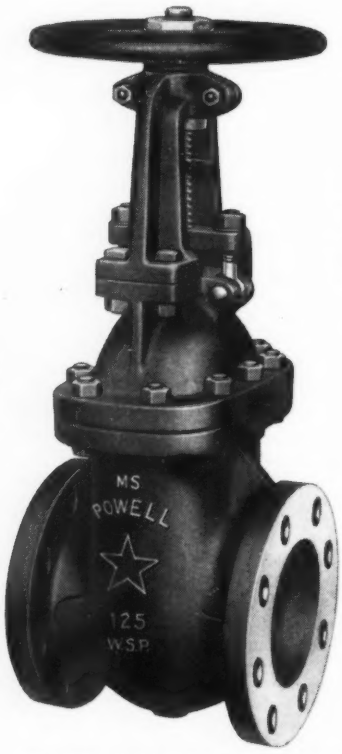


Fig. 1793—Large 125-pound Iron Body Bronze Mounted Gate Valve. Made in sizes 2" to 30", inclusive. Has outside screw rising stem, bolted flanged yoke and tapered solid wedge.

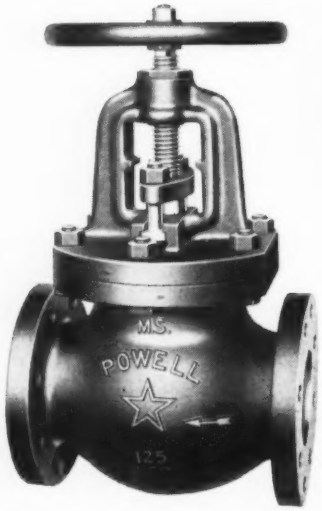


Fig. 241—Large 125-pound Iron Body Bronze Mounted Globe Valve. Made in sizes 2" to 16", inclusive. Has outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc.

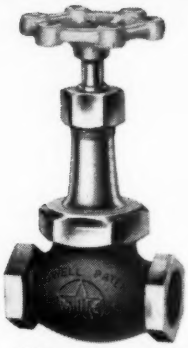


Fig. 1708 — 200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable specially heat treated stainless steel seat and regrindable, renewable "Powellium" wear-resisting nickel-bronze disc.

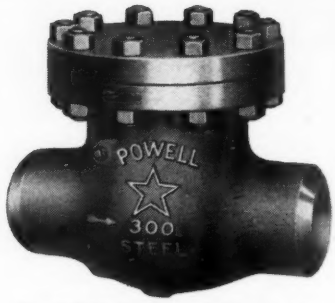


Fig. 3061 W. E.—Class 300-pound Cast Steel Swing Check Valve with welding ends and bolted cap.

Fig. 375 — 200-pound Bronze Gate Valve. Screwed ends, union bonnet, inside screw rising stem and renewable "Powellium" wear-resisting nickel-bronze disc.

Fig. 19031 W.E.—New Class 900-pound Cast Steel, Flangeless Bonnet, Streamlined Pattern, Globe Valve with welding ends and spur gears. (Shown with gear cover removed). This improved design reduces pressure drop and turbulence to the minimum.

POWELL

complete line of for POWER PLANTS

As we come to the end of one hundred and two years of operation, we are more than ever convinced of the soundness of the policy we adopted more than a century ago. This was *to make valves only* and *to make every kind of valve* required by every branch of industry.

In the field of power, the net result of our strict adherence to this policy is an exceptionally complete line of Valves for Power Plants. This includes Bronze and Iron Valves of every necessary type and design and an equally complete line of Cast Steel Valves—Globe, Angle, Gate, Check and Non-return—including many special designs and in pressure classes from 150 to 2500 pounds.

The Wm. Powell Company, Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

Fig. 1303 W. E.—Class 1500-pound Cast Steel Gate Valve with welding ends, bolted flanged yoke, outside screw rising stem and tapered solid wedge.

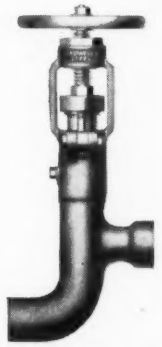


Fig. 1331-A—Class 1500-pound Steel Integral Bonnet Offset Globe Valve with welding ends. Also available in Angle and "Y" patterns.

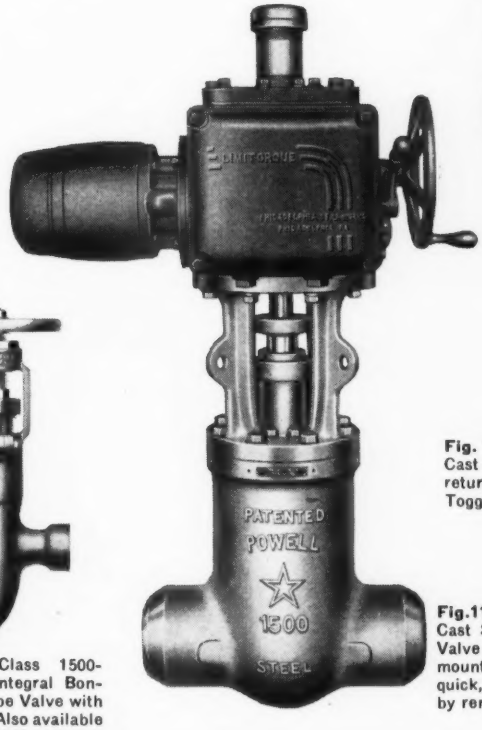


Fig.11323 W.E.—Class 1500-pound Cast Steel Flangeless Bonnet Gate Valve with welding ends. Has top-mounted electric motor operator for quick, positive opening and closing by remote control.

Fig. 11393 W.E.—Class 1500-pound Cast Steel Flangeless Bonnet Non-return Angle Valve with welding ends. Toggle operated.

VALVES

Bomb

attack on boiler problems

Any thorough study of boiler water problems involves investigations under conditions which simulate those of actual boiler operations. That is the reason for "bombs"—strong, thick walled cylinders of various sizes and types in which water or solutions of various kinds can be subjected to the highest temperatures and pressures encountered in modern boilers.

These "bombs" are a standard tool at Hall Laboratories. Sometimes they are used in studying the solubility of a substance, sometimes to investigate decomposition of different solutions at those high pressures and temperatures, sometimes to determine the effect on the bomb metal —which is the same as the metal of the boiler— of various substances that are found in or added to boiler water.

Through this and other methods of inquiry, Hall Laboratories learns not merely what reaction takes place in a test tube but *what will happen in your boiler.*

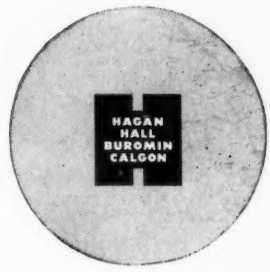
"Bomb" studies are typical of the thoroughness with which Hall Laboratories investigates every aspect of boiler water conditioning. The original Hall system of boiler water conditioning was based on thorough research, and thorough research maintains Hall leadership — which is one more reason why so many plants of all sizes, in all industries, in all parts of the country, use Hall service.

Hall Laboratories, Hagan Building, Pittsburgh 30, Pennsylvania.

HALL LABORATORIES, INC.

(A Subsidiary of Hagan Corporation)

CONSULTANTS ON
INDUSTRIAL WATER TREATMENT
HALL SYSTEM OF BOILER WATER CONDITIONING
INDUSTRIAL WASTE RECOVERY AND DISPOSAL



instant response

ROCKING CONTACT

with Allis-Chalmers ROCKING CONTACT Voltage Regulators

And that's only one benefit! Accuracy, low maintenance and dependability are equally important. Here's how the Rocking Contact principle gives you *all four:*

The regulator operates in the exciter shunt field circuit to give instant response . . . no time wasting relays involved.

Contact sectors rock on jeweled bearings . . . no vibrating contacts . . . no gliding friction to hinder accuracy or response.

There are no complex adjustments to make. Simplicity of design means years of trouble-free service to you.

Rocking Contact regulators are available for both a-c and d-c generators of any size and speed, for either parallel operation or unit control. Call our representative in your nearby A-C office, or write direct.

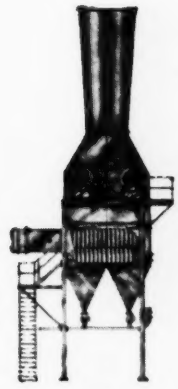
ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.

Type 366 *Rocking Contact* Generator Voltage Regulator. Dust-proof design encloses all moving parts in neat switchboard case.

A 2556

ALLIS-CHALMERS

Pioneers in Power and Electrical Equipment From Generation Through Utilization

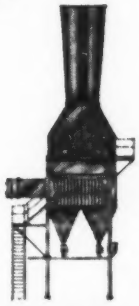


The Secret of CONTROL

Thermix Fan Stacks produce a definite controlled degree of draft—because in a unit packaged design they combine, (1) the induced draft fan, (2) the breeching connecting the fan and stack and (3) the stack itself. All *three* are interdependent and affect the controlled, overall operation. To design, engineer and purchase these parts separately would not produce the same accurate, known results that this packaged unit offers.

And what about Tubular Dust Collectors? Thermix offers multiple small diameter tubes for high centrifugal force and resulting efficiency, plus the added advantage of smaller space requirements and more accurate dust control for your plant.

A call to the field engineer nearest you will place at your disposal a specialist in the field of flue gas control.



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THE THERMIX CORPORATION

First National Bank Bldg. **Greenwich, Conn.**

(Offices in 28 principal cities)

Canadian representative: **T. C. CHOWN, Ltd., *1440 St. Catherine St. W., Montreal 25, Quebec***

PRAT-DANIEL CORPORATION

Manufacturers of Thermix Equipment

EAST PORT CHESTER, CONN.

E-M JOB-ENGINEERED

Protection!

FOR HEAVY-DUTY INDUCTION MOTORS

One of industry's most pressing needs has long been induction motors that can be depended on to operate with year-in-and-year-out reliability on the toughest, heavy-duty jobs. It is a need that has resulted in the brilliant engineering and sturdy construction of E-M Squirrel-Cage Induction Motors, with their indestructible rotors, long-life insulation and cool-running, wear-resistant bearings.

Along with the other extra-value advantages of these heavy-duty motors comes E-M job-engineered protection.

This protection gives added assurance of reliable performance. Without it, there is constant danger under most conditions of water or other destructive agents falling into the vital parts of the motor and eventually causing damage and costly repairs.

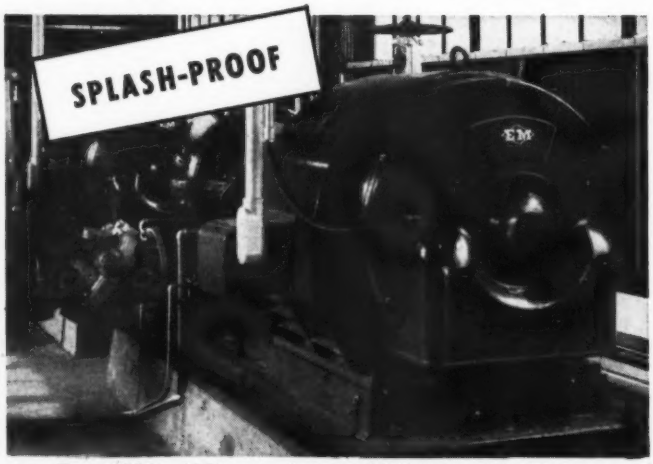
E-M Induction Motors are available with the following types of job-engineered external protection:

DRIP-PROOF—A strong, steel shield provides protection over a 30° arc, safeguarding the motor against falling liquids or particles. Drip-proof construction is recommended in conditions when the more complete protection of splash-proof or enclosed construction is unwarranted.

SPLASH-PROOF—A full 200° arc of protection safeguards motors with splash-proof construction. It is a type of construction found advisable in many paper mill, chemical plant and pumping plant installations and is recommended whenever there is danger of splashing or flying particles, as in hosing down floors.

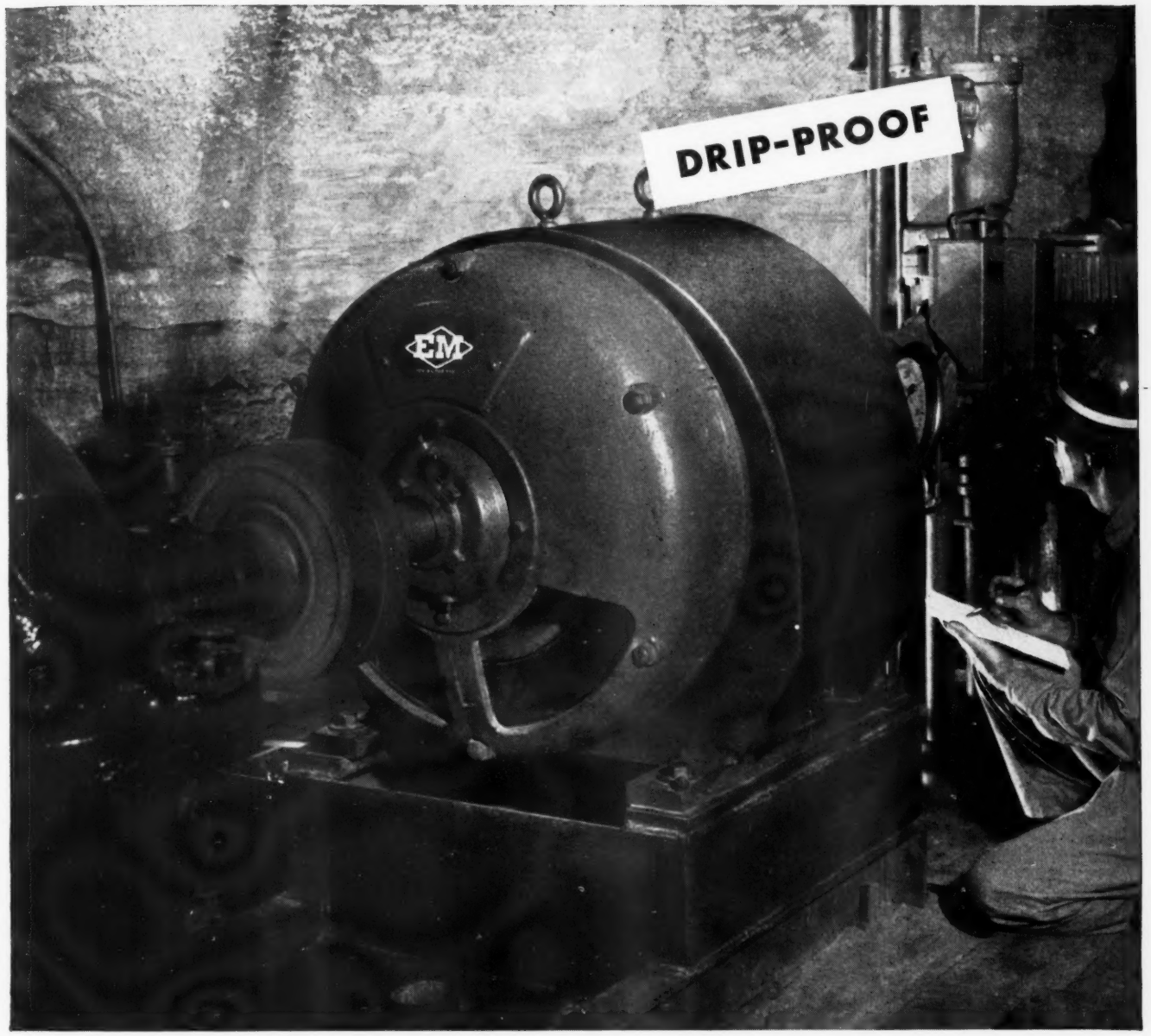
Enclosed, Self-Ventilating or Separately Ventilated—These are special types of motor protection recommended when there is excessive air contamination or high air temperatures, and it is desirable to either filter the air or to draw it from cooler, uncontaminated sources.

40 YEARS OF BIG MOTOR KNOW-HOW HELPS BUILD OUTSTANDING INDUCTION MOTORS



Three 400 hp, 1800 rpm splash-proof E-M Motors drive booster pumps in Southland Paper Mills plant at Lufkin, Texas. Regular hosing-down operation can't touch E-M Motors protected in full 200° arc against damage.

One of 3—1000 hp, 1800 rpm, 4160 volt Squirrel-Cage Induction Motors for Texas Pipeline Co. to operate in locations where surrounding air is contaminated with Hydrogen Sulphide gas, weak acid and abrasive dust.



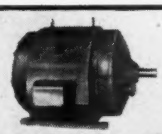
Heavy-duty Induction Motor of drip-proof construction is protected against falling particles and dripping liquids in the St. Joseph Lead Company mine at Leadwood, Missouri.

A little improvement in designing gives a lot in extra value

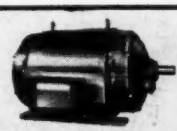
In the E-M drip-proof motor shown above—Note that the frame flares out at the bottom to accommodate the extra volume of discharge air in that region. This is another instance where E-M's experience in big motor engineering results in more efficient design.

Important things have been happening in induction motor design and construction at Electric Machinery . . . things that mean a big difference in induction motor reliability, economy, maintenance. Write now for the full story . . . just ask for your publications 189 and 190.

Types of E-M Squirrel-Cage Induction Motors



Two-pole; drip-proof; ring lubricated bearings



Two-pole; drip-proof; pressure lubricated bearings

Four or more poles; drip-proof; sleeve bearings

Four or more poles; splash-proof; ball bearings

ELECTRIC MACHINERY MFG. COMPANY, MINNEAPOLIS, MINNESOTA

E-M

SPECIALISTS IN BIG MOTOR ENGINEERING

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INVESTIGATE
The Public Utility STOKER

Detroit RotoGrate is an advanced design of spreader stoker with forward moving grates that discharge the ash at the *front*. Intermittent cleaning of the fires and disturbance of uniform combustion is eliminated.

Burns any Bituminous Coal or Lignite with high efficiency.

Requires no special fuel preparation.

Permits high burning rates—increases capacity.

Maintains high CO_2 with or without preheated air.

Operates without clinker difficulties or slagging in the furnace.

Combustible loss in the ash pit is low.

Handles fluctuating loads—responds quickly to sudden changes.

High availability is assured.

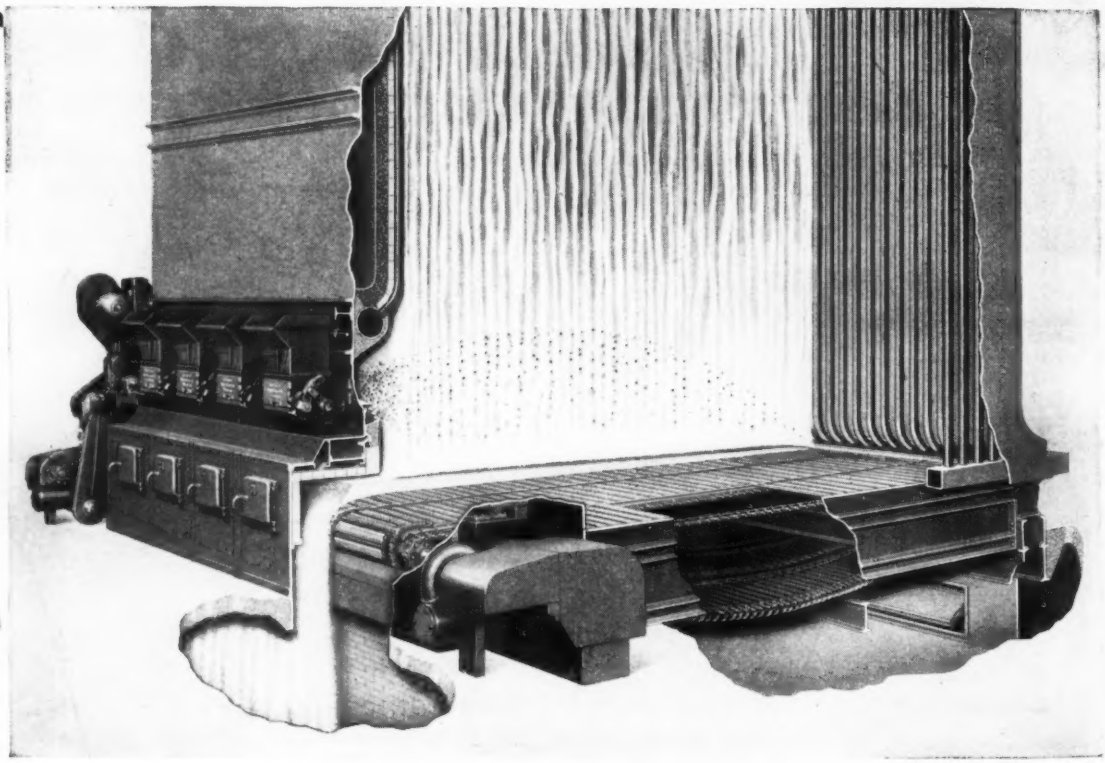
Northern States Power
Five Contracts—Four plants
Wilmarth—Lawrence—
French Island—Red Wing

Central Illinois Electric & Gas
Fordam and
Sabrooke Stations

Ohio Public Service
Mahoningside

Central States Electric

Central Iowa Power Cooperative



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selected by these

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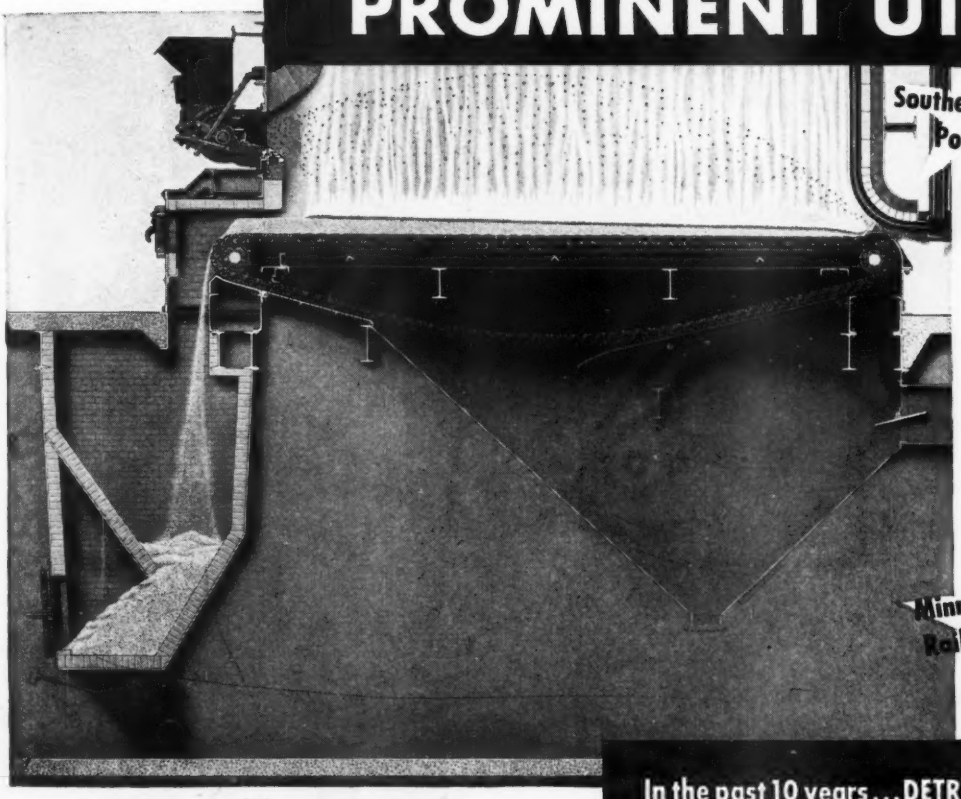

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Missouri Public Service

Sioux City Gas and Electric
Kirk Station

Minneapolis Street Railway Company

In the past 10 years... DETROIT ROTOGRATE STOKERS have revolutionized coal burning. Ask any user.

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Hoot Lake Station

Public Service Company of Oklahoma

Montana-Dakota Utilities
Two Plants

Black Hills Power and Light

Lake Superior District Power
Bay Front Station

Indianapolis Power and Light
Perry W Station

Iowa Public Service
Six Contracts—
Five Plants

DETROIT ROTOGRATE STOKER

DETROIT STOKER COMPANY

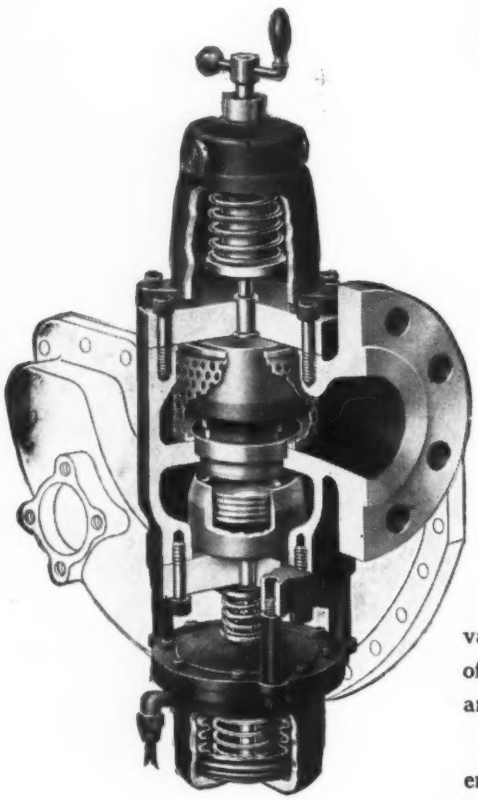
GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN

WORKS AT MONROE, MICHIGAN • DISTRICT OFFICES IN PRINCIPAL CITIES

THE new G-E standard mechanical-drive turbine—the Type DP—is a machine designed by turbine *users*. This new design was undertaken after an exhaustive survey, covering hundreds of turbine users, indicated the features *you* rated most desirable.

Formerly most of these features were obtainable at a price addition in a "special" machine. Now, as a result of superior design and greater standardization, we offer these special features as standard equipment —at no extra cost. This, we believe, makes the new Type DP the greatest value in small turbine history!

NEW G-E TURBINE OFFERS AT NO EXTRA



FOR THE FULL STORY

If you have steam available, these *new* turbines can work profitably for you. G-E sales engineers and turbine specialists will be glad to show you how your equipment can benefit from the features of G-E turbine drive. And, their wide experience is at your disposal.

For full information please contact the nearest G-E Apparatus Sales Office. Or, write today for GEA-4955, a fully illustrated, 20-page descriptive bulletin. Apparatus Department, General Electric Company, Schenectady 5, N. Y.

For many applications the combined trip-throttle valve—an exclusive G-E feature—makes a separate shut-off valve unnecessary, saves you the cost of purchasing an extra valve.

The trip-throttle valve and the governing valve are an entirely new balanced reaction design, requiring very little force to operate. No soft packings are used.

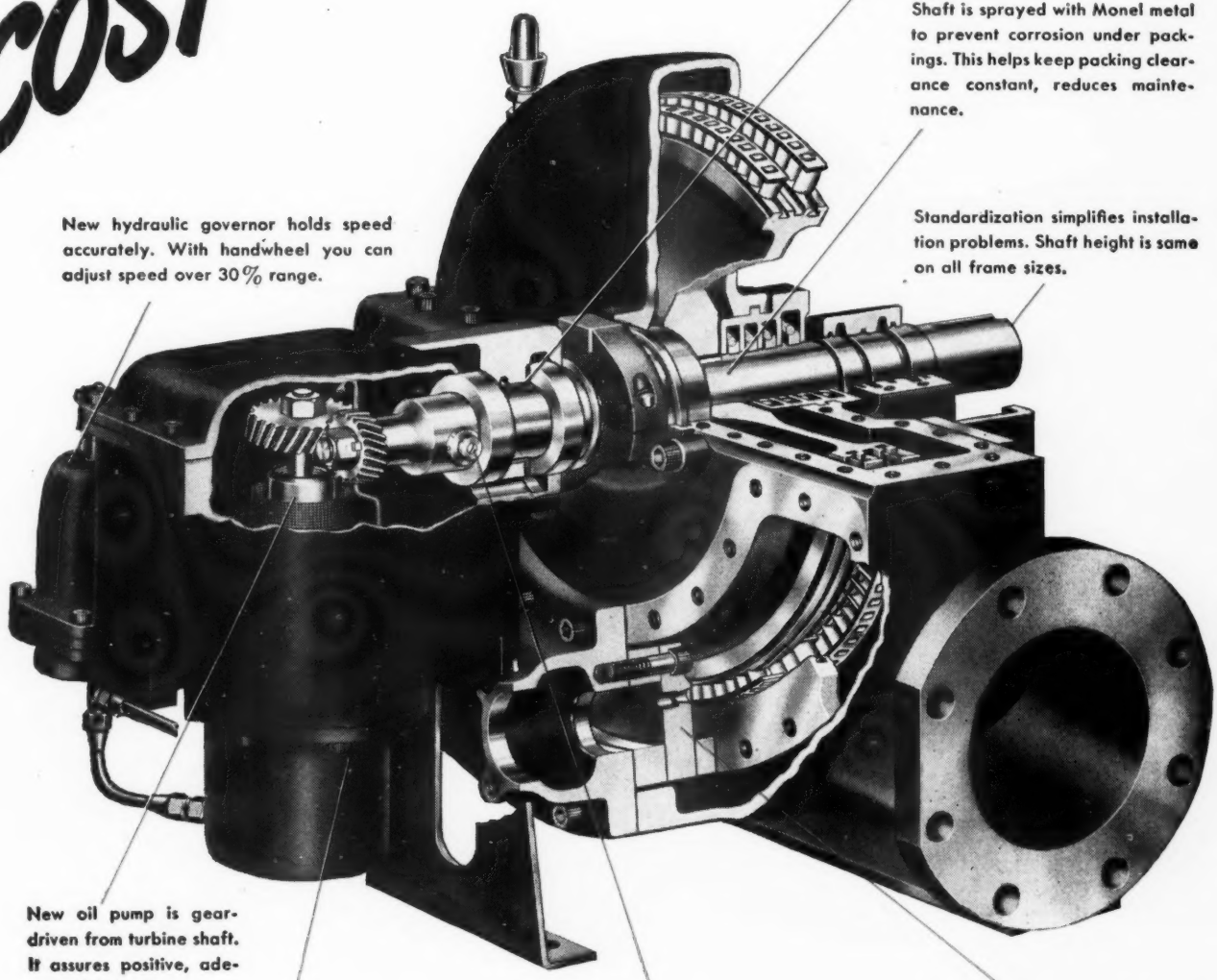
YOU SPECIAL FEATURES COST

New solid-backed bearings wear better, last longer. Thrust surfaces accurately position rotor, prevent misalignment troubles.

Shaft is sprayed with Monel metal to prevent corrosion under packings. This helps keep packing clearance constant, reduces maintenance.

New hydraulic governor holds speed accurately. With handwheel you can adjust speed over 30% range.

Standardization simplifies installation problems. Shaft height is same on all frame sizes.



New oil pump is gear-driven from turbine shaft. It assures positive, adequate lubrication.

New oil cooler assures positive cooling of lubricating oil, reduces chances of bearing failure. Cooler is readily accessible, easily removed.

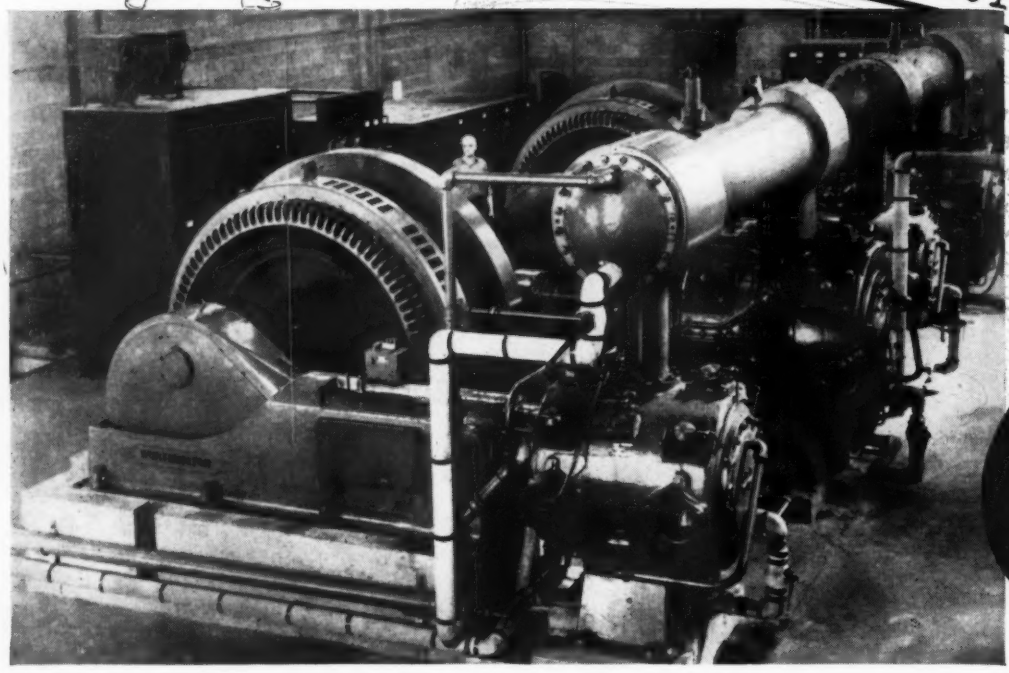
New nonsparking emergency governor assures positive overspeed protection. It is totally enclosed in an oil atmosphere, thus not subject to rusting or sticking.

Nozzle plate is made of special steel to resist corrosion and erosion. Thus high efficiency of your turbine will be maintained.

GENERAL ELECTRIC

252-27

LONG-RANGE FORECAST: "Considerably Cooler with Lower-Cost Air"



Worthington Horizontal Duplex Compressors, Type DC-2
A plant installation of two 600 hp units

You can depend on this prediction of Worthington compressor-performance to be 100% accurate — every time! In DC-2's, for example, cooler operation is assured by such exclusive Worthington features as:

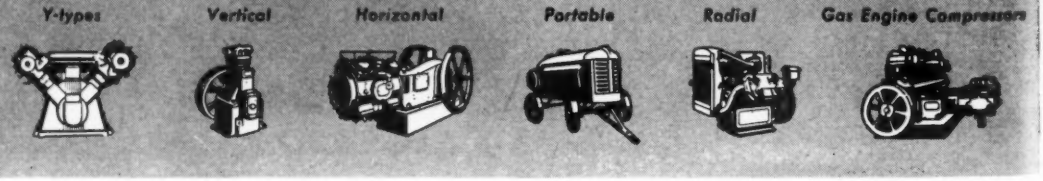
- **Advanced Variable Capacity Control** — Most modern, simple and flexible ever devised. Accurate, automatic regulation that cuts down operating heat with better lubrication and reduced carbon deposits.
- **Improved Intercooling** — High-efficiency design that provides maximum cooling with minimum water, for lower power requirements and lower operating temperatures.
- **Feather*Valves**—Lightest, tightest, most efficient ever made — a famous Worthington contribution to compressor-development.

These and many other DC-2 advantages mean not only more air for less money, but longer compressor life and constant savings in power and maintenance costs. Bulletin L-675-B1A has the complete story that proves *there's more worth in Worthington*. Write for your copy to *Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, N. Y.* *REG. U. S. PAT. OFF.

WORTHINGTON

K8-5

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON



For Heavy Duty Steam Generating Plants

Springfields'

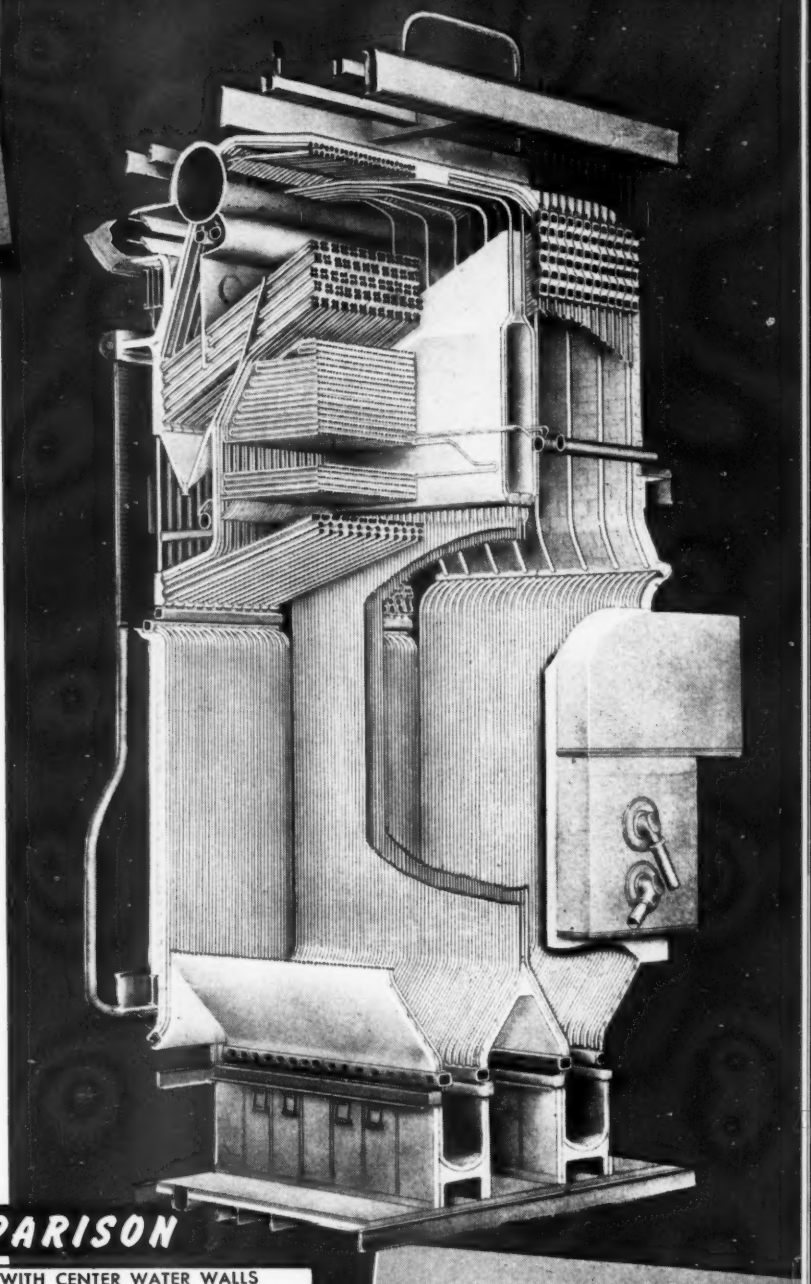
DIVIDED FURNACE WITH CENTER WATER WALL

THE divided furnace with a CENTER WATER WALL* is a development first introduced by Springfield Boiler Co., for large central station installations. It has application where gas temperatures entering the first pass and superheater must be limited to prevent overheating of the center section of the wider furnaces. It enables a unit to stay on the line longer before shutting down for maintenance and cleaning.

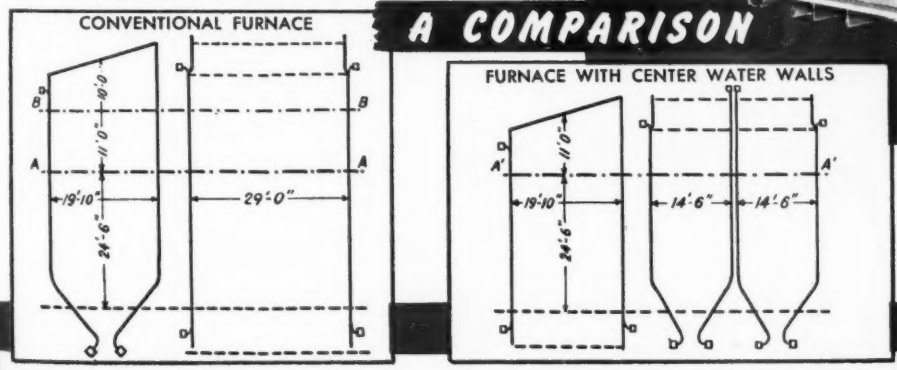
The divided furnace construction has been highly dependable and successful in service. It is adaptable to any kind of firing. Springfield offers it on both bent tube and straight tube boiler designs.

*Patented

CHECK WITH YOUR CONSULTING ENGINEER ON YOUR MODERNIZATION AND NEW PLANT PROJECTS



A COMPARISON



These diagrams show how the *center water wall* made it possible for Springfield to reduce the height of furnace 22% on one 350,000 lb. pulverized coal fired unit in addition to securing a more even gas temperature entering the first pass across the width of the unit.

SPRINGFIELD PRODUCTS

BENT TUBE STEAM GENERATORS—Modern designs for capacities from 10,000 lbs. up.

STRAIGHT TUBE BOILERS—Specially designed for capacities from 5,000 to 450,000 lbs. per hour and higher.

STANDARDIZED TYPE M BOILERS—Standardized for quicker delivery and lower cost. Sizes 6,000 to 17,000 lbs. per hour.

WATER COOLED FURNACES—Heavy duty water walls. Exclusive center water wall construction for larger units.

SUPERHEATERS — AIR HEATERS — ECONOMIZERS—Individually designed to meet requirements.

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Everywhere

In WASHINGTON it's ELECTRUNITE
FOR BOILER INSTALLATION AT
NEW WEST CENTRAL HEATING PLANT
Another in the ever growing list of installations in which Republic ELECTRUNITE Boiler Tubes have been included as original equipment
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it's ELECTRUNITE
INSTALLED AS ORIGINAL EQUIPMENT IN NEWEST STEAM GENERATING UNIT AT THE DAYTON RUBBER COMPANY
In Buffalo
it's ELECTRUNITE
. . . INSTALLED IN MODERN STEAM GENERATING UNIT AT U. S. RUBBER RECLAIMING CO., Inc.
AGAIN in Cleveland
it's ELECTRUNITE
. . . IN THREE NEW STEAM GENERATING UNITS FOR THE CLEVELAND ELECTRIC ILLUMINATING COMPANY

it's ELECTRUNITE

. . . THE MODERN BOILER TUBE FOR BOTH NEW AND REPLACEMENT INSTALLATIONS

● Power plants in Cleveland and Peoria . . . processing industries in Newark, Dayton and Alton . . . heating plants in Washington and Chicago . . . these are but a few of the countless installations in which Republic ELECTRUNITE Boiler Tubes deliver dependable performance day after day, year in and year out.

There are many reasons why boiler manufacturers, engineers and maintenance men prefer ELECTRUNITE Boiler Tubes—all of them resulting from Republic's *modern* improved process of electric resistance welding by which they are made.

For the complete story about this process and the cost-saving advantages which it imparts to ELECTRUNITE Boiler Tubes, or the answers to specific questions regarding your own new equipment or retubing problems, write *today* to:

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York

These modern *tubes roll in and head over to tight, non-leaking joints in a hurry. Many users report up to 30% faster installation time due to the remarkably uniform ductility and freedom from hard spots throughout every length of Republic ELECTRUNITE Boiler Tubes.*

Republic ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

It Pays to

LOOK BEYOND

"Materials Handling"

There comes a time when *mechanized bulk materials handling methods*, which once were a big improvement, can be reviewed with very promising opportunities of profit. Today materials handling averages 36% of production cost. Methods do not stand still any more than costs do.

●

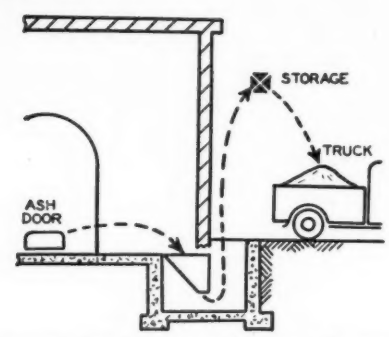
Even comparatively recent installations should be re-examined in terms of today's product requirement, today's costs and today's plant layout.

●

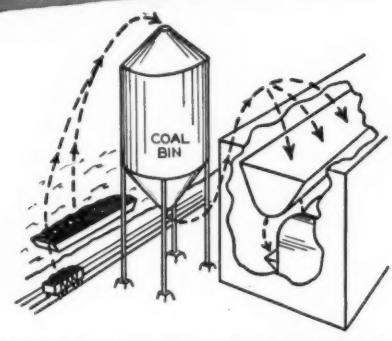
We can help. Stephens-Adamson engineers claim no miraculous formula — only complete familiarity with the problem. An invaluable "know-how" grows up in a staff of men during years of repeatedly finding the "best practical way" under new sets of conditions. Equally important, their recommendations are not influenced by particular types of conveyors, elevators, hoists, etc. which their company "happens" to make. We make all types and can recommend the most suitable for any particular requirement.

●

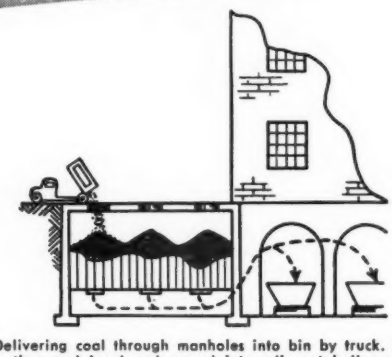
See Our Exhibit
and the
NEW ZIPPER CLOSED-BELT CONVEYOR-ELEVATOR
in Operation at Booth Nos. 218-220
NATIONAL POWER EXPOSITION
Nov. 29-Dec. 4



Moving ash from boilers to outside storage for eventual disposal by truck.



Unloading coal from cars or barges and elevating to outside storage bin. Coal is then reclaimed and moved to bunker for direct delivery to stoker hoppers.



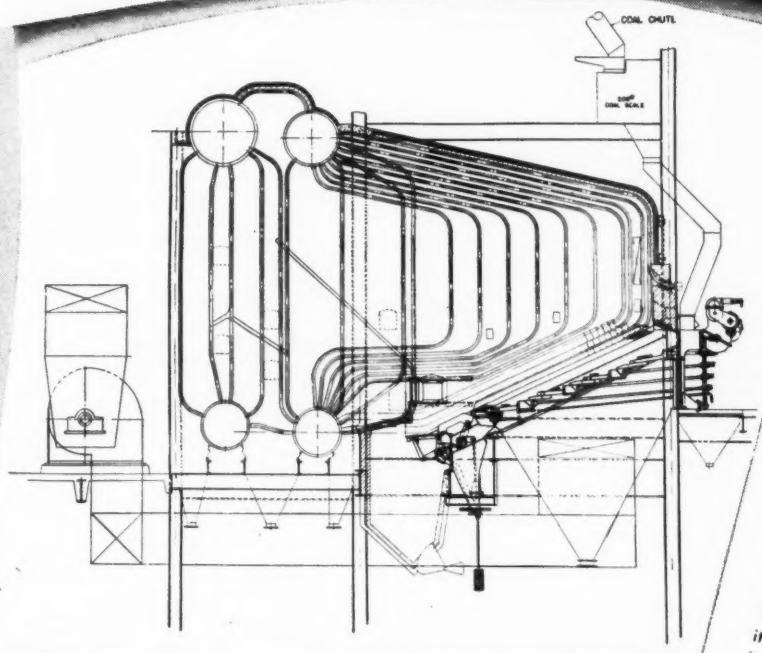
Delivering coal through manholes into bin by truck. Coal is then reclaimed and moved into adjacent boiler room.

STEPHENS-ADAMSON MFG. CO.

5 RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. • BELLEVILLE, ONT.

Designers and Manufacturers of All Types of
BULK MATERIAL HANDLING EQUIPMENT

Here's the Stoker for: **LOWER POWER COSTS**
FREEDOM FROM STACK NUISANCE
MAXIMUM FUEL FLEXIBILITY



Recent Installation Burns Low Grade Fuels

A large Eastern manufacturing plant uses a Taylor Multiple Retort, Underfeed Stoker with continuous ash discharge. The unit operates continuously at 125,000 lbs. per hour although designed for 105,000 lbs. per hr. Designed to burn bituminous coal with 16% ash content and heating value of 12,800 BTUs per lb., it recently handled strip mine coal having only 10,000 BTUs per lb., proving its ability to burn low grade fuels and carry its rated capacity.

Taylor is the stoker that beats the high cost of fuels. It has been proved in installation after installation that Taylor Stokers permit the use of a wide variety of type and sizes of fuels. You can feed the Taylor Stoker any kind of coal that's convenient to you . . . for price, labor, delivery and mine location.

Taylor's precision control feed mechanism and better air flow means thorough combustion, maximum fuel economy, and *freedom from stack nuisance*. Simplified construction results in fewer moving, longer-wearing parts, higher operating efficiency, and lower boiler outages. These and many other exclusive features combined add up to efficient, low-cost steam production.

Get more information about the flexible, versatile Æ Taylor Stoker now. Write to us today for literature and engineering help. Ask us to make recommendations—no obligation.

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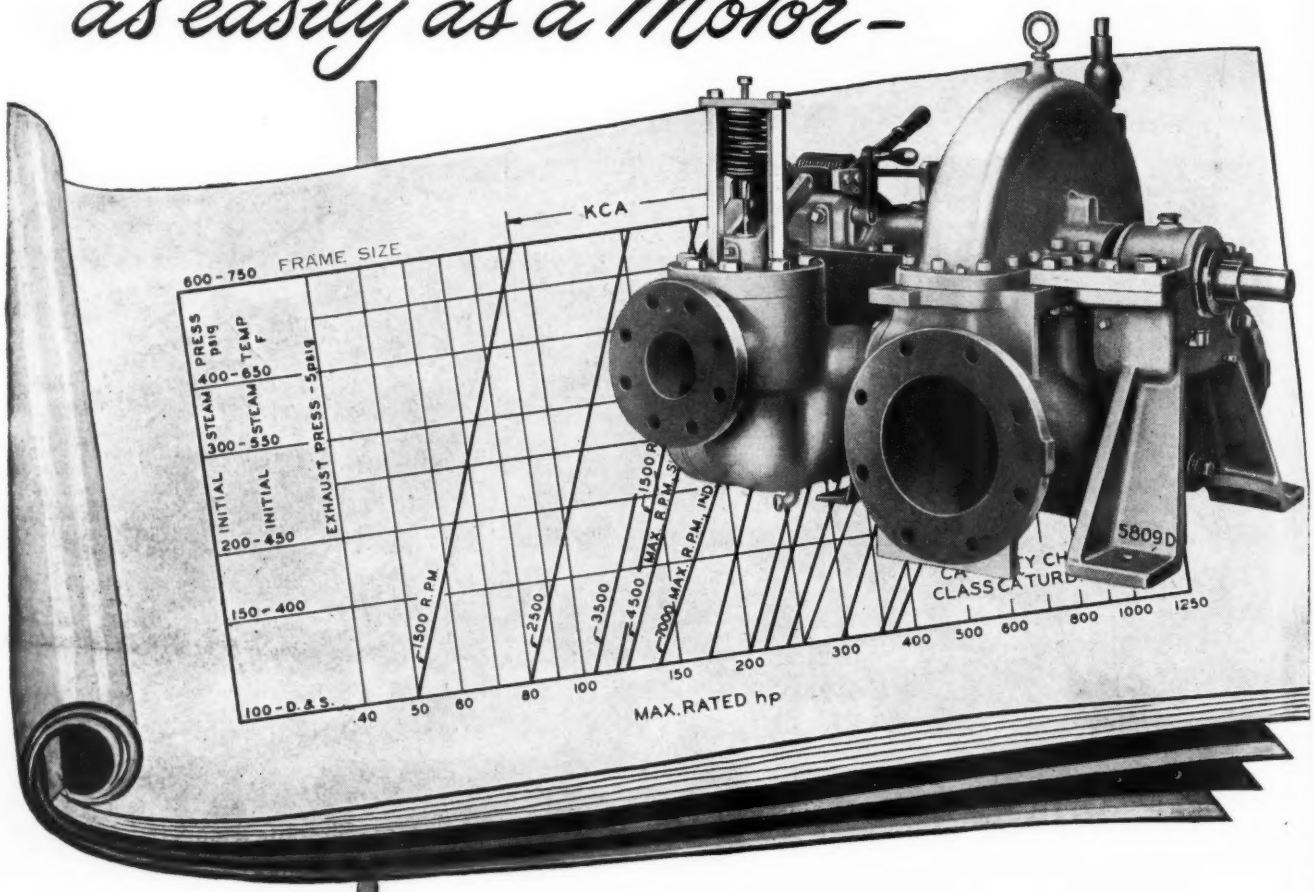
Now YOU CAN SELECT A TURBINE *as easily as a Motor–*



SIMPLIFIED RATINGS FACILITATE SELECTION OF NEW DE LAVAL MECHANICAL DRIVE TURBINES

Because of the great demand for the reliability, speed variability and economy inherent in mechanical drive steam turbines, the De Laval Steam Turbine Co. has designed a new standardized line of velocity stage turbines, manufactured these units in quantity for prompt delivery, and published simplified rating tables that make the preliminary selection of the right turbine size as easy as the selection of an electric motor.

Send for catalog describing the new and improved De Laval Class CA velocity stage steam turbine for mechanical drives.

DE LAVAL

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DECEMBER 1948 VOLUME 92, NUMBER 12

A CROSS-INDEX OF SUBJECTS FOR THE MONTH

PLANT OPERATING METHODS, MAINTENANCE AND SAFETY
STEAM GENERATION, FUELS, FIRING AND COMBUSTION
TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
DIESELS, GAS ENGINES AND ACCESSORIES
AIR CONDITIONING AND REFRIGERATION
ELECTRICAL EQUIPMENT, ELEVATORS
PIPING, VALVES AND SPECIALTIES
TRANSMISSION, LUBRICATION
STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

SPECIAL SECTION

FUELS AND FIRING 71
- How fuels burn—fundamentals in easy-to-understand form .. 72
- Facts about fuels—gas, oil and coal 77
- Burning gas and oil—typical equipment 84
- Pulverized-coal firing—mills, feeders and burners 89
- Burning coal on overfeed stokers 98
- Burning coal on underfeed stokers 104
- Selecting fuels for new plants and old 110
- How to figure combustion—short-cut methods 114

FEATURE ARTICLES

Slave Falls plant is completed 119
Condenser that travels on trailers 120
Growing demand expands Barbadoes 122
Capacitors improve power factor and cut costs 123
How to select the most economical V-belt drive 125
London plans first oil-fired central station in Britain 127

DEPARTMENTS

Electronics: 8, reactors and transformers 129
Power engineer's notebook of plant-tested ideas 134
Solving problems from the power plant 138
What's new in plant equipment 142
Data sheet: Water conditioning with sodium sulphate 150
Technical briefs: digests of recent developments 152
News of the power field 156
Reader service page of new equipment and technical literature .. 202A

VOLUME 92, NUMBER 12 • ABC • ABP •

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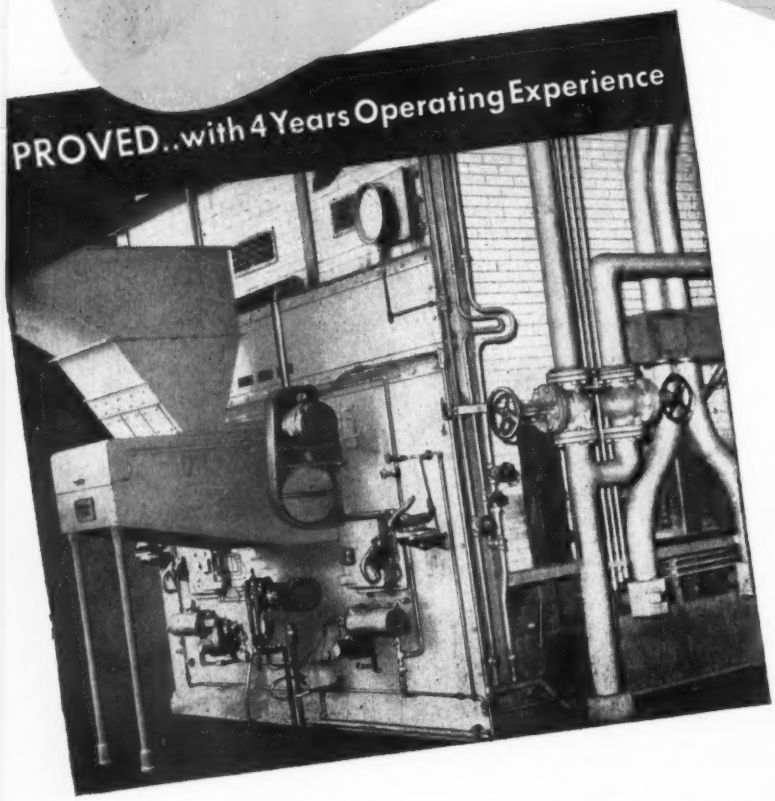

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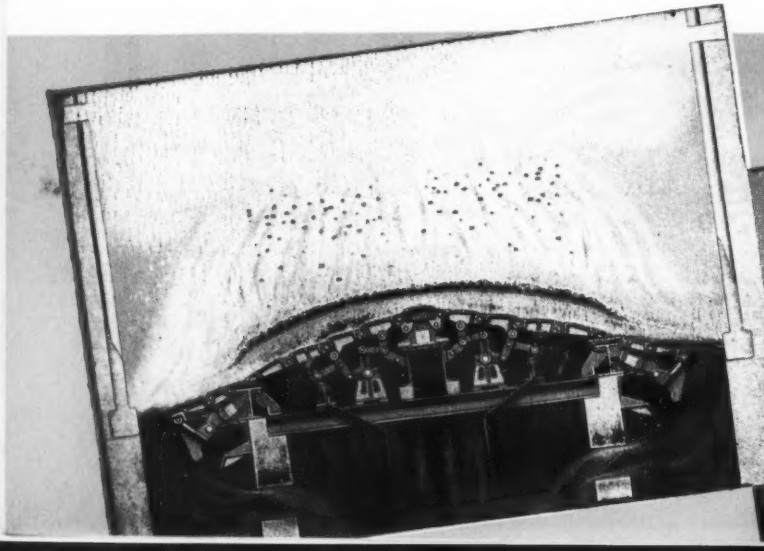

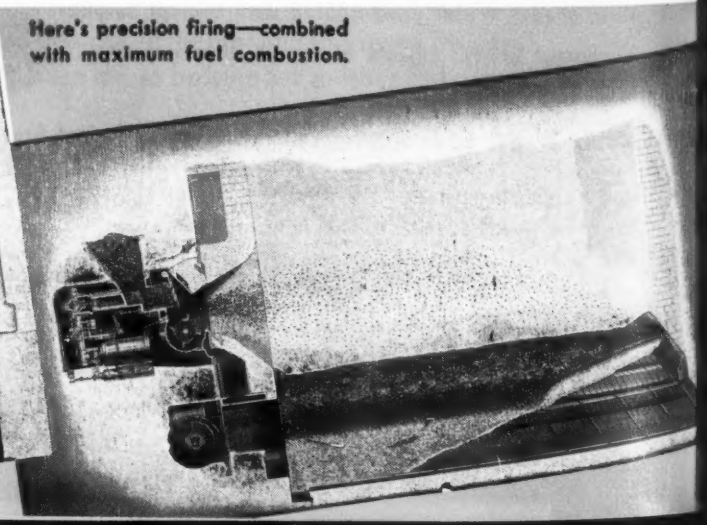

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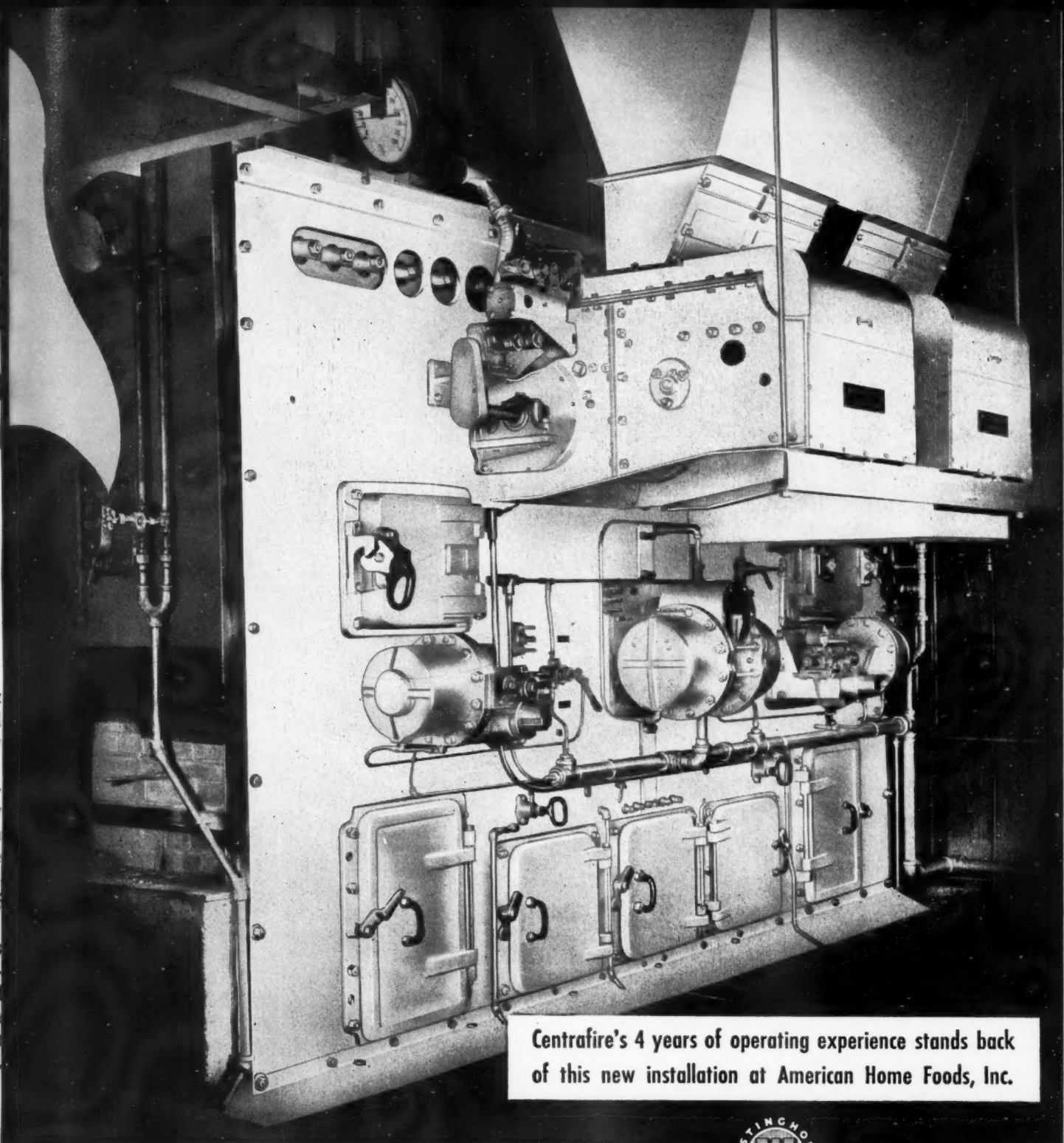

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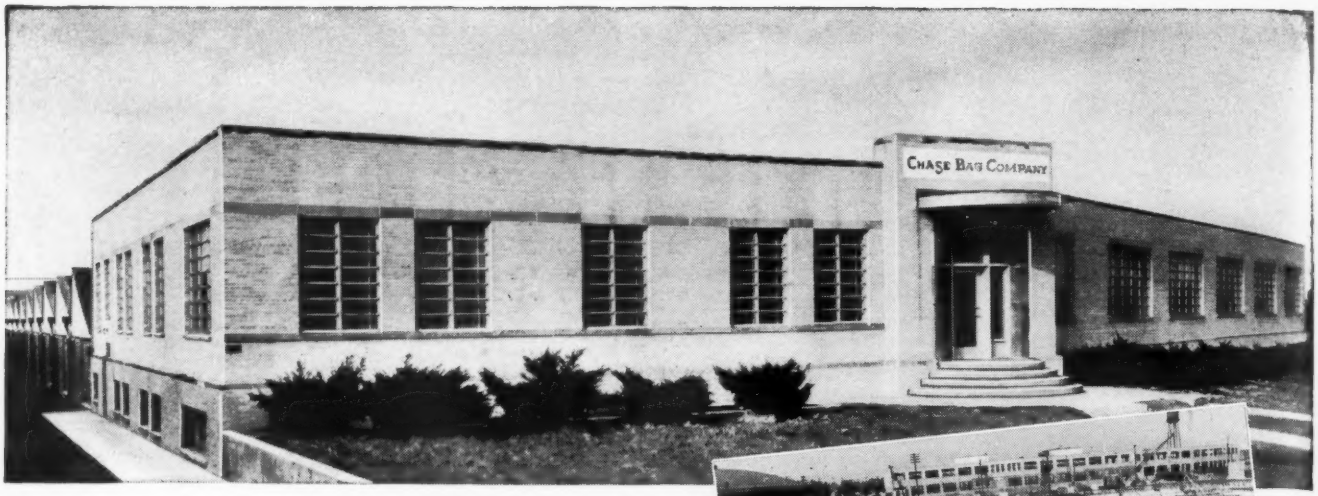

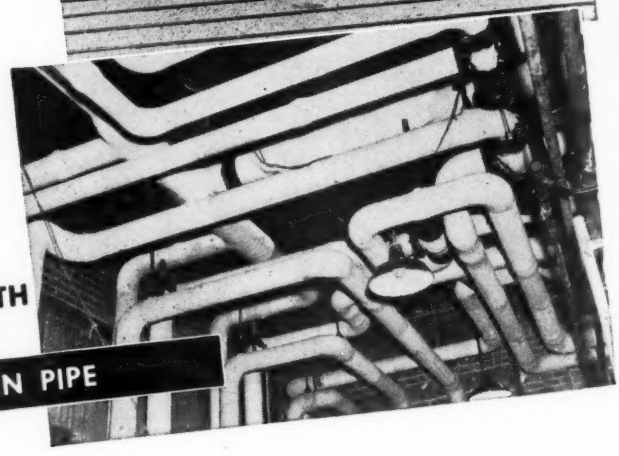

MORE BIG INDUSTRIAL INSTALLATIONS

4

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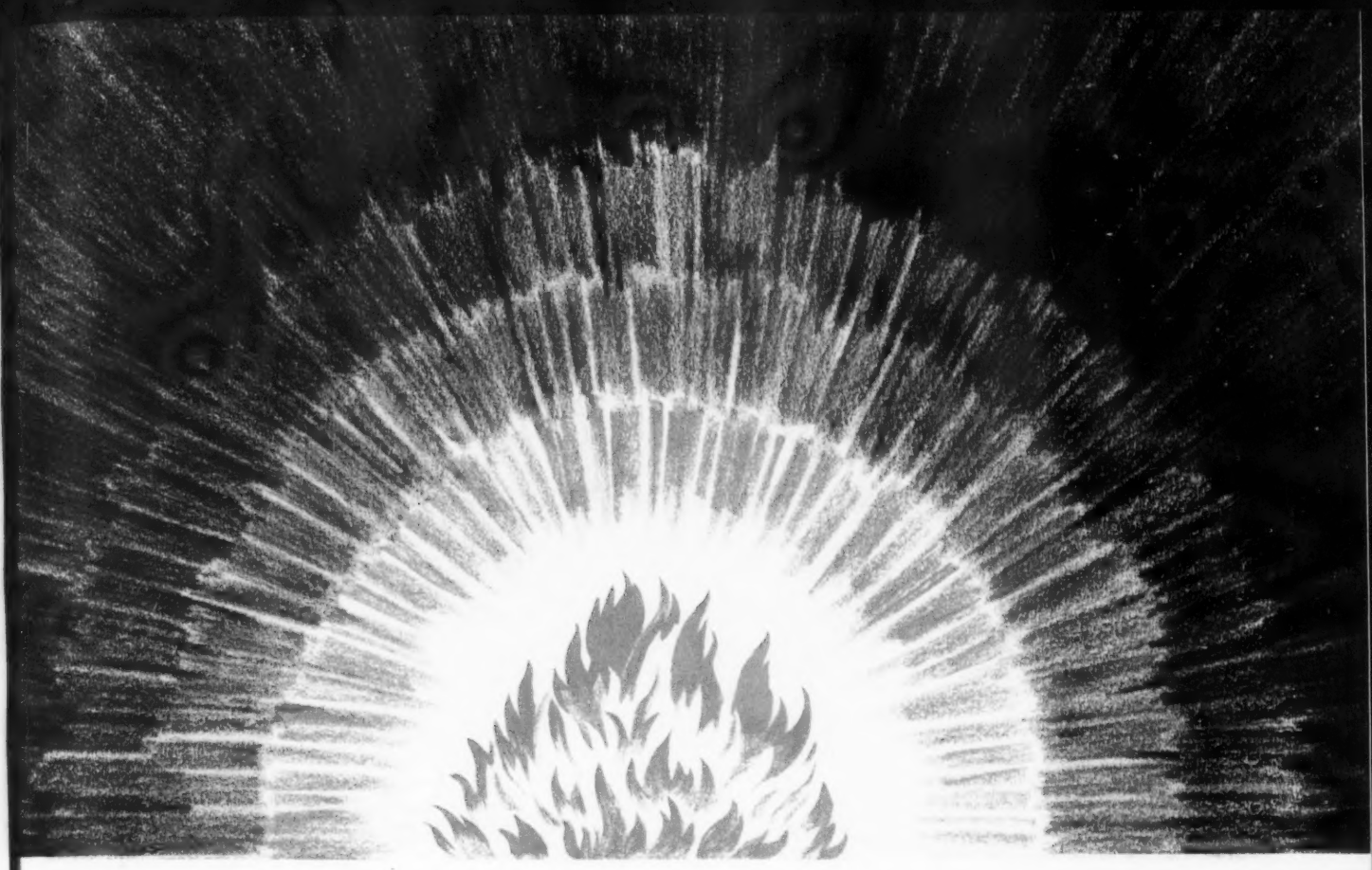


Fuels and Firing

By L N ROWLEY, *Managing Editor*, J C McCABE and B G A SKROTZKI, *Associate Editors*

From those dawn times when our hairy ancestors squatted about a flame before a cave, fire has been an intimate associate. It gave cozy warmth and kept back the creeping dark. It smelted ores, made metal malleable for forging. In later days it generated steam and pushed mightily on engine pistons.

No wonder the ancients viewed fire as one of the "elements," along with the other cornerstones of their world — earth, air and water. No wonder fire has been and still is worshipped by savage peoples. No wonder traces of that age-old feeling appear in our sentimental appreciation of a glowing hearth.

Down through the centuries, as fire came ever to play a greater part in man's life and work, the nature of "burning" remained secret. Not until the classical experiments of Lavoisier, Priestley and other 18th-century scientists swept aside the mystical ideas of the Middle Ages did the process stand revealed as a reaction with oxygen from the air.

From that time on we have gained steadily in our knowledge of burning. Learned that it is more complex chemically than we first thought. Learned that good combustion is mainly a mechanical problem. Learned many practical things about fuels and efficient firing. Learned above all how little we know.

Today the reaction by which fuel and oxygen combine and give off heat is still the most important single process in our universe. Heat is the power engineer's stock in trade and combustion a process he lives with daily. As fuels become ever more expensive to obtain, and as energy demands skyrocket, nothing is more necessary than an understanding of the manner in which fuels burn and how to put them to work with peak effectiveness.

To aid that understanding is the aim of this special section, POWER's 70th. In 48 practical pages, it tells how fuels burn, gives facts about commercial fuels, describes firing equipment, shows how to select fuels wisely for new plants and old, and outlines short-cut methods for checking efficiency.

How Fuels Burn

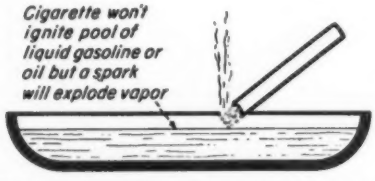
All around us, at all times, oxygen combines with other elements. Iron and oxygen combine to form the *oxide* we know as rust. Silver tarnishes, copper takes on a soft green oxide coat. This general process is *oxidation*. Burning, or *combustion*, is a special form of oxidation. In it, oxygen combines rapidly with materials we call *fuels* and substantial amounts of heat are liberated.

Under some conditions, combustion may be self-starting. For example, coal piled outdoors combines slowly with oxygen in the air, giving off heat. If the heat doesn't get away, temperature rises, the reaction speeds up and eventually becomes rapid enough to be called burning.

How Burning Starts.

Such *spontaneous combustion* is relatively uncommon. We are more familiar with combustion that begins with heat applied from some outside source. A fire laid in the grate will not light itself. Nor, for that matter, will a match. We start the burning process by striking it to generate friction heat enough to set it aflame, then use the flame's heat to light kindling, and the kindling's heat to start the logs. This process of using an easily ignited object to provide heat for ignition of another is common in engineering.

We are all aware that some things burn more readily than others. In general, this depends on how easy it is to turn the particular substance into a gas, *because nothing truly burns unless or until it is a gas*. This, in turn,

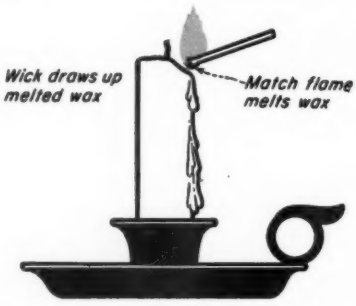


Nothing burns unless or until it is a gas

depends on the nature of the substance and on its amount compared with the amount of heat available to start the process. It's easier to start wood burning than coal, and easier to ignite a twig than a log.

A candle illustrates the point well. To make wax burn, we turn it into a gas. With a wick, heat from a match flame does the trick easily; without a wick it can't be done. Why? Without a wick, the match's heat is so small in comparison with the mass of wax that it can do no more than melt a little. None is vaporized, because there just isn't heat enough. Adding a wick changes the picture.

The wick draws up, by capillary action, an amount of melted wax so small in relation to the match flame that enough heat is available to raise the wax to the temperature needed for vaporization. Once wax is vaporized,



Wick draws up melted wax by capillarity

or made like a gas, burning is relatively easy to start. Burning the wax gives off enough heat to continue the process of melting, vaporizing and igniting.

Although the wick is eventually consumed, it contributes nothing to the burning. It is a purely mechanical device to create conditions needed to start and maintain combustion. It finds its counterpart in burners, stokers and furnaces, for while combustion is essentially a chemical reaction, most practical problems of fuel burning are mechanical.

Combustion of Gases.

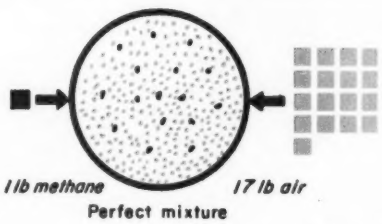
Since our fuels burn as gases, or as if they were gases, we need some acquaintance with the rules governing combustion of gases. Assume we have a gas, either a fuel that is normally gaseous, or a gas given off from a solid or a liquid fuel. In burning this gas, or any gas, it is first necessary to have a gas-air mixture that will ignite and then to raise this mixture to the ignition temperature and hold it there. Let's look first at this business of combustible mixtures.

To start with, we are working with two basic fuel elements—hydrogen and carbon. Sulphur and some other elements burn and give off heat, but common practice considers the reactions negligible and the elements impurities. Hydrogen is normally a gas and can only be liquified at an extremely low temperature—more than 400 F below zero. On the other hand, carbon is a solid that cannot be completely vaporized at temperatures much under 6300 F. Heating values are high: 62,000 Btu per lb for hydrogen and 14,500 Btu per lb for carbon.

Carbon and hydrogen exist in almost innumerable combinations called *hydrocarbons*. Many of these compounds, like methane (CH_4), are normally gaseous and form a major part of most important fuel gases.

Air Required.

Although the form in which these two elements appear in any actual fuel is vastly important to its burning, as we will see later, it makes no difference from the chemical balance-sheet angle. The important thing here is that each element or compound needs a certain amount of oxygen for complete combustion. It thus becomes easy (see p 114) to figure exactly how much oxygen we must have to burn a given amount of gas and, further, just how much air we need. If we mix exactly this much air with the gas we have a *perfect* or *theoretical* mixture. The relation be-



Perfect-mixture amounts for air, methane

tween gas and air is called the *fuel-air ratio*. This is usually expressed by weight. For any particular fuel, this ratio can be figured from the chemical analysis.

Ignition Temperature.

Now we have a combustible gas and the exact amount of air to burn it completely. We need still another element—heat. If such a perfect mixture is heated gradually, rate of chemical combination increases until a point is reached where the reaction no longer depends on heat from an outside source and practically instantaneous combustion occurs. Lowest temperature at which this happens is the *ignition temperature*. It may be defined as the temperature at which heat is generated by the reaction faster than it is lost to the surroundings, and combustion thus becomes self-propelling. Below this point the gas-air mixture will not burn freely and continuously unless heat is supplied to it.

Actual ignition temperature depends to some extent on surrounding conditions, and the term usually refers to

combustion in ordinary air. Among other factors, pressure affects ignition temperature, which is lower at high pressures.

These statements apply equally to mixtures that are not perfect, that is, to mixtures a little leaner or a little richer than perfect. But for each gas there is a point where the mixture becomes too lean or too rich for ignition and continued burning. Almost every automobile owner has cussed a flooded carburetor that produced too rich a mixture and made starting difficult. Most of us have also seen the same engine miss fire when the carburetor is adjusted for too lean a mixture. Thus, for each gas there is a range of mixtures that will ignite and continue to burn. These are called *inflammable mixtures*. Limits of this range are known as limits of inflammability.

Practical Mixing.

Thus far we have looked at this business of mixtures and burning as if the right amount of gas was mixed with the right amount of air, and the entire mixture heated and burned in one operation. In actual practice this happens only rarely. Nearest approach is in the cylinder of a gas engine. In

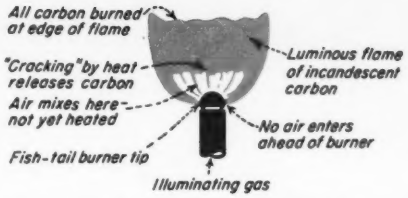
Gas engine has near-perfect mixture

boiler firing, and other furnace work, we meet not with a single mass of ready-made gas-air mixture but rather with air and gas streams, which must be brought together and heated somehow to start and maintain ignition. The way this mixing is accomplished, and its effectiveness, makes all the difference in the nature of combustion and its completeness.

The familiar Bunsen burner of the laboratory and the fishtail burner once used in gas-lighting systems show up these differences clearly. The Bunsen burner displays a relatively small, blue, *nonluminous* flame, while the fishtail burner shows a larger, yellow, *luminous* flame. With the same gas, why the difference?

Yellow-Flame Burning.

The answer lies in the way air and gas mix, and shows clearly how the time and place of this mixing affect the process by which the fuel elements, particularly the hydrocarbons, burn. In the fishtail burner, gas flows through a slotted opening in a thin flat stream. The dark area near the burner tip is


All carbon burned at edge of flame
"Cracking" by heat releases carbon
Air mixes here not yet heated
Fish-tail burner tip
Luminous flame of incandescent carbon
No air enters ahead of burner
Illuminating gas

Fishtail gas burner shows yellow flame

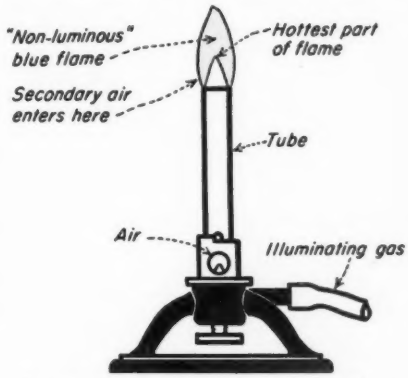
cold gas in the process of picking up and mixing slightly with air. Suddenly the mixture reaches correct proportion and starts to burn rapidly only a few hundredths of an inch from relatively cold, too-rich mixture.

Here we run into an action commonly known as "cracking" or, more fully, *thermal decomposition*. When hydrocarbons are subjected to high temperature they crack or break down chemically into other carbon and hydrogen combinations and eventually into the basic ingredients, carbon and hydrogen. This is what happens to some of the gas near the edge of the flame where heat is intense. The cracking action sets free hydrogen, which burns in the flame, and carbon particles, which glow to incandescence and make the flame yellow and highly visible.

Normally carbon burns out pretty well by the time it reaches the flame edge. But if we put any cold object in the flame, the carbon particles are chilled and the burning stops. Resulting deposit of lamp-black or *soot* is identical with similar deposits in boilers. If these microscopic particles of carbon "that didn't finish burning" stay suspended in the products of combustion, we have *smoke*.

Blue-Flame Burning.

In the Bunsen burner, gas issues from a small jet at the base of a mix-



Bunsen burner operates with blue flame

ing tube. Air is drawn in through a side opening. Gas and air mix before reaching the flame area and the result is a nearly colorless "blue" flame.

The secret lies in the fact that gas and air mix before reaching the combustion zone and are heated more slowly than in the fishtail burner. This gives oxygen a chance to penetrate the hydrocarbon molecules and form oxygenated compounds. The process by which oxygen associates with hydrocarbons is known as *hydroxylation*. As will be explained more fully later, the new compounds thus formed burn with an entirely different flame. There is no cracking and no carbon is formed. Thus a change in the point of mixing, and rate of applying heat, produces an entirely different burning process.

Good Mixing Vital.

This simple example yields several ideas of great importance in this combustion business. First is the key part played by mixing. In actual flames and combustion spaces we have widely different mixtures side by side. In one area the mixture may be too rich to burn, as it was close to the tip in the fishtail burner. In other areas we may

Poor mixing versus good mixing

have almost all air and hardly any fuel. This unsatisfactory situation may prevail even though the average relation of fuel to air over the entire space may be correct for good burning. By evening out these inequalities, thorough mixing makes the actual furnace condition more nearly like the "statistical" average.

The example also shows what happens when carbon breaks away from its compounds. Microscopic particles formed are carried along in the stream with little or no motion relative to the air. This makes them extremely difficult to burn even if the process is not stopped, as by chilling.

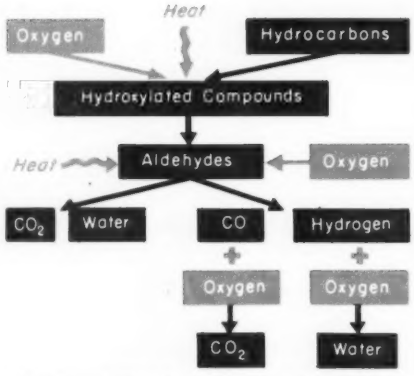
Finally, and perhaps most important, we see that combustion is not quite so simple as it seems. It is true that we start with only two fuel *elements*, and that by simple equations we can show that they combine with oxygen to form water, carbon dioxide and, under some conditions, carbon monoxide. This is much like saying that two men traveling from New York to Chicago have identical journeys. Their experiences would depend on how they went, and by what route, and only by knowing these could we tell something about their trips.

Burning Hydrocarbons.

Burning of gaseous hydrocarbons is a good case in point. Complete analysis

of flue gas from gas- and oil-fired furnaces often reveals presence of chemical compounds known as *aldehydes*. Formaldehyde is a fairly familiar member of this group. Nothing in our simple carbon-to-carbon-dioxide and hydrogen-to-water reaction explains the presence of these compounds. How did these strangers get into the parade?

Part of the answer lies in our comparison of two types of gas burners. Under one set of conditions, as we have seen, oxygen associates with the hydrocarbon molecules, producing *hydroxylated* compounds that are unstable. These form aldehydes which, in turn, break down or oxidize until formaldehyde is produced. What happens next depends on how much oxygen is present. Formaldehyde may break down with heat to form carbon monoxide and hydrogen, or it may burn to water and carbon dioxide or carbon monoxide. Any carbon monoxide and hydrogen formed burns in the normal way.

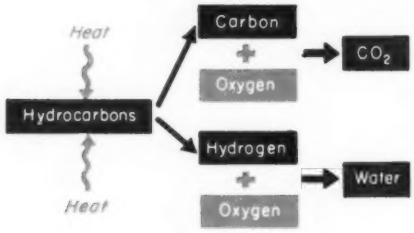


Hydroxylation burning of hydrocarbons

So it is clear that quite a few changes occur between the beginning and end of the burning operation and that many intermediate products form and disappear. If combustion is incomplete, some of these compounds remain and show up in the flue gas. The faint acrid odor sometimes observed indicates the presence of one group of intermediate compounds, aldehydes.

Cracking Process.

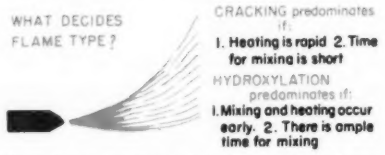
From our gas-burner example, we also saw that under different conditions, hydrocarbons are cracked instead of hydroxylated. Such cracking breaks them down into carbon and hydrogen,



Cracking process in hydrocarbon burning

which burn to carbon dioxide and water. We have seen that it is the incandescent carbon which gives such a flame its characteristic yellow color, and it is the carbon which gives it soot-and-smoke-forming propensities.

We have talked about these two ways hydrocarbons burn as if they were entirely separate. In virtually all practical burning of hydrocarbons, however, both processes go on simultaneously and the general character of the flame depends on which predominates. This, in turn, depends on surrounding conditions. Early mixing and preheating of hydrocarbons and air, plus time for the oxygen molecules to enter the hydrocarbon molecules, favor hydroxylation. Rapid heating, and lack of mixing time, favor thermal decomposition.


WHAT DECIDES FLAME TYPE?
CRACKING predominates if:
1. Heating is rapid 2. Time for mixing is short
HYDROXYLATION predominates if:
1. Mixing and heating occur early. 2. There is ample time for mixing
What fixes nature of hydrocarbon flame?

We've belabored this business of hydrocarbons for two reasons: (1) Biggest part of practical combustion work involves them; natural gas and oil are hydrocarbon fuels, so is the volatile matter of coal. (2) It shows clearly that while our familiar chemical equations for combustion are useful in calculating air requirements, etc, we must know more about what happens between the starting point and the finish if we are to design and operate successful firing equipment and furnaces. *The actual combustion process may consist of several reactions and their nature depends on the form in which the basic elements carbon and hydrogen appear in the fuel, and the way burning takes place.*

Elementary Fuels.

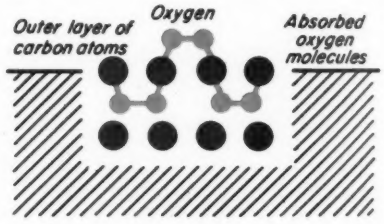
Thus, to understand practical combustion problems we must take a look at each of the forms in which carbon and hydrogen appear in commercial fuels and the steps through which they pass in burning. This isn't as tough as it sounds, since for our purposes we can consider all complex fuels as combinations of three simple or elementary fuels: (1) gaseous hydrocarbons (2) solid carbon and (3) mixture of carbon monoxide and hydrogen. Each of these general groups contains a variety of fuel substances which differ in minor respects (charcoal and coke in the solid-carbon class, for example), but each group displays a generally similar pattern of combustion.

Some commercial fuels are simple mixtures of these elementary fuels. For example, coal gas is essentially a mixture of gaseous hydrocarbons and carbon monoxide plus hydrogen. With other familiar fuels, our elementary fuels come into being during the burning process; fuel oil volatilizes into gaseous hydrocarbons before actual combustion. Some cracking may also occur, yielding solid carbon and hydrogen.

Coal is another fuel that decomposes into elementary fuels before actual combustion starts. When first exposed to the fire's heat gaseous hydrocarbons, carbon monoxide and hydrogen are distilled off, leaving solid carbon behind. Hence to know what actually happens when coal burns we must know the individual burning processes of all three elementary fuels.

How Carbon Burns.

We've got the toughest of these under our belts, having already seen how gaseous hydrocarbons burn. The way carbon burns has puzzled the experts for many years but careful experiments seem to back up the current theory. This assumes that oxygen penetrates the carbon surface to break away atoms which hook up with the oxygen



Oxygen combines with outer carbon atoms

in a loose sort of carbon-oxygen compound that is unstable. It is not a true chemical compound because proportions of carbon and oxygen atoms are not fixed, nor is it entirely a mixture, since the oxygen cannot be driven off. Depending on temperature and other conditions, this *physiochemical* compound breaks up into carbon dioxide and carbon monoxide. If there is an excess of oxygen, carbon monoxide is oxidized to carbon dioxide., If carbon is in excess, dioxide is reduced to monoxide.

Burning H_2 and CO.

Hydrogen and carbon monoxide are grouped together as an elementary fuel because they commonly occur together and their burning processes are alike. In ordinary combustion work, conditions are such that both burn according to the familiar simple reactions:

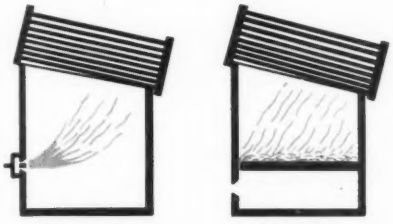
$$2H_2+O_2=2H_2O$$
$$2CO+O_2=2CO_2$$

Hydrogen burns more than 2.5 times as fast as carbon monoxide when they burn together with excess oxygen.

Actual Firing Job.

Now, with these fundamentals out of the way, we're primed to tackle the job of burning commercial fuels in actual furnaces. Just what is this job? In broadest terms, it includes: (1) preparing the fuel and air (2) converting the complex fuel into elementary fuels (3) bringing these fuels and air together in the right proportions and at the proper temperature for ignition and combustion, and (4) transferring heat from the products of combustion to the boiler or other surfaces while retaining enough heat in the combustion zone to maintain volatilization and ignition. All these actions are going on at the same time in any furnace, and each particle of fuel traces the entire sequence, in order, in its brief passage through the furnace.

Broadly speaking, there are two ways to handle this job: (1) in *suspension* or (2) on a *fuel bed*. Let's look at both



Practical fuel burning takes two forms

to see how they differ and, more important, in what ways they are alike.

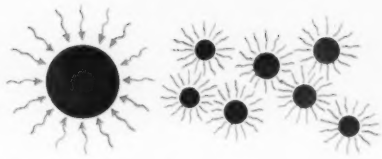
Suspension Firing.

When we think of suspension, or *burner firing*, gas comes immediately to mind as the simplest example. Here we have a fuel already in the gaseous state, ripe for quick mixing with air. Gas burners thus need only proportion the volume of air and gas to insure thorough mixing. As we shall see later when examining actual burner designs, they differ mainly in how and when this mixing occurs.

Burners for oil and coal, in addition to proportioning fuel and air, and mixing them, must *prepare* the fuel. For oil, this means making it ready for conversion from liquid to gaseous hydrocarbons. For coal, it involves distilling off the volatile matter (gaseous hydrocarbons again, plus hydrogen and carbon monoxide). This must be done in the instant after the fuel enters the furnace.

Preparing Fuel.

It is the furnace heat that does the conversion; job of the firing equipment is to put fuel into shape that makes best use of this heat. For suspension firing of both oil and coal the answer is the same—it must be broken up into many small particles to expose as


Small particles show more area to heat

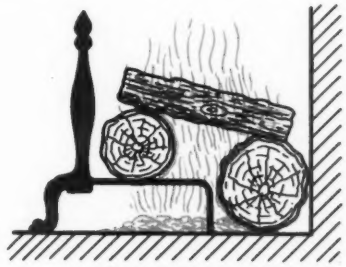
much surface as possible. With oil, *atomization* is obtained in a variety of ways by the burner; with coal *pulverization* is handled in a separate unit, the burner merely mixing the finely ground particles with air and injecting them into the furnace.

In addition to small particles, we need fast motion between particles and air to strip away the microscopic "coats" of gas that form on the particles and thus expose fresh surfaces to heat and air.

Furnace's Job.

The furnace takes over where the burner leaves off, providing the conditions for continuous complete combustion. Within the combustion zone, fuel must be vaporized or distilled, mixed with air, ignited, and the resulting reactions between fuel and oxygen carried to a finish. Chief responsibility for bringing fuel and air together rests with the burner; the furnace can do little to correct failure of the burner in this respect. On the other hand, the heating and igniting job is predominantly the furnace's.

The difficulty met in trying to burn a single log in a fireplace illustrates the part played by good furnace design. As anyone who has tried will testify, a single log is one of the hardest things in the world to keep burning, while a number of logs will blaze merrily. The answer lies in the fact that


Logs reflect heat to each other

when there are several logs, each reflects heat to the others, for distillation of volatile matter and ignition. In the same way a furnace must maintain a heat supply to prepare and ignite incoming fuel.

Soot and Smoke.

With either coal or oil, some carbon formerly associated in hydrocarbon compounds breaks away as free carbon and, of course, a substantial part of most coal is solid carbon. Thus we always have the problem of burning carbon particles, which, as we have seen, proves extremely difficult even with ample time. Here is the germ of smoke and soot. Naturally, if the furnace is small and cold areas (boiler tubes and the like) are badly located, carbon cannot possibly burn to completion.

All these steps—bringing air and fuel together, raising mixture to ignition temperature, sweeping away successive layers of gas from fuel particles, burning carbon as far as possible — occur while fuel and air travel from burner to furnace outlet, an extremely short

In combustion, time equals distance

time. Just how much depends on the distance traveled and the speed, and whether or not flow is *turbulent*.

Turbulent Mixing.

By turbulence, we mean a condition in which fuel and air whirl and eddy in irregular paths instead of flowing in streamlines from burner to furnace outlet. This has several beneficial effects: (1) There is an increase in the time available for combustion. (2) Better mixing of fuel and air results. (3) Fuel and air move past each other at higher velocity, thus helping to sweep away combustion products and expose fresh surfaces. It has been well said that successful combustion depends on three "T's" — Temperature, Time and Turbulence.

Ash and Slag.

So far, we have ducked the question of mineral impurities (ash) found in many fuels and particularly in coal. These, of course, do not burn. In suspension firing, if nothing else happened, some particles would be carried out of the furnace with the gas stream (*flyash*) while others would drop out of suspension in furnace or boiler passes. This simple picture is complicated by the fact that, depending on the nature of the ash, and to some extent on surrounding conditions, ash becomes plastic and sticky. If it comes in contact with relatively cold surfaces while in this plastic state it forms *slag* coatings, reducing rate of heat trans-

fer, hindering flow of gases through boiler passes, and creating a maintenance problem. Later, in pulverized-coal firing, we'll see some practical steps to avoid such slagging difficulties.

Fuel-Bed Firing.

After this quick run-through of suspension-firing fundamentals we're ready to take an equally quick look at fuel beds. In this kind of firing, fuel is pushed, dropped or thrown on a grate in a high-temperature region within the furnace. Air flows upward through the grate and through the fuel bed that forms on it. The "green" coal is heated, volatile matter distills off and *coke* is left on the grate. Coke burns to a mixture of carbon dioxide and carbon monoxide, and ash remains.

The volatile matter of the coal, and the carbon monoxide from the coke burn *over* the fuel bed with air that has come up through it and, usually, *secondary* air admitted to the furnace over the grate. Thus anywhere from 40 to 60% of the coal's heat is liberated over the fuel bed. We thus see that burning gases is still a big part of the job even with fuel-bed firing.

To help understand what happens in the fuel bed, divide it into four zones, one above the other. In actual beds, location and shape of these zones varies depending on grate construction and how the fuel reaches it. For simplicity, we can visualize the beds as more or less uniform layers extending across the grate. From top down, these zones are: *distillation, reduction, oxidation* and *ash*.

Fuel-Bed Zones.

At the top, green coal receives furnace heat, volatile matter distills off, and the coke thus formed works down through the bed as lower layers burn out and new coal is added. In the oxidation *zone,* coke is burned to carbon dioxide with the primary air rising through the bed. This carbon dioxide travels up through the zone above and is partly reduced to carbon monoxide by contact with hot coke. The layer of ash at the bottom protects the grate from excessive heat.

Oxygen in the primary air is pretty much used up a few inches above the grate, this being the oxidation zone. If it were not for air that rises rapidly through blowholes and leaks around edges, there would be little oxygen above this point except that brought in with secondary air. Increasing amount and velocity of primary air speeds up burning but does not alter the fact that oxygen is largely consumed a short distance above the grate.

Only a little carbon monoxide is formed until all oxygen is gone, but rate of CO formation becomes rapid immediately this point is reached, that is, at the beginning of the reduction zone. As distance from the grate increases, CO continues to form, but at a slower rate. Thus the thicker the fuel bed, the more CO is formed. Because reduction of CO_2 to CO depends on time of contact between gas and coke, higher air velocities mean less CO.

Fuel-bed temperature depends largely on rate of firing, being higher at high rates. Usually temperature within the bed is somewhat greater than at the surface. If this temperature is above that at which ash fuses, clinker may form. More about this later.

Overfire Burning.

As we have seen, about half the burning job must be done in the space above the fuel bed. How successfully this is done determines largely the efficiency of the entire operation. The job is complicated by the fact that composition of the combustible gases above the fuel bed varies from point to point and uniform distribution of air is hard to obtain. *Stratification* is likely to result, that is, there will be separate streams of gas and air leaving the furnace without mixing. As in all forms of firing, *excess air,* above the amount required for theoretically complete combustion, is supplied. This increases the chances for air and gas to meet and mix.

Furnace Size.

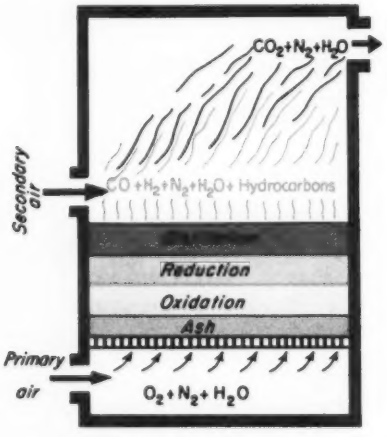
Size of combustion space is of utmost importance. In general, the less excess air, the larger must be the space. Naturally, more space is needed for higher burning rates. For any given set of conditions, size of combustion space largely determines completeness of combustion. Of the "given conditions", mixing is perhaps most important. With poor mixing, combustion is likely to be incomplete no matter how large the space, while with good mixing combustion may be completed quickly and added space would be of no value. Incomplete combustion means heat loss in the form of unburned CO and carbon. Likewise, high excess air means loss of sensible heat in the flue gas.

Turbulence Again.

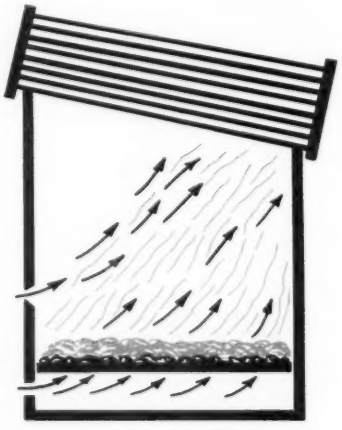
Best all-round balance of these factors results from a furnace design that makes maximum use of space. Here again turbulence proves the vital factor. Modern practice leans strongly to devices such as high-velocity jets to obtain good penetration, high turbulence and thorough mixing. By this means, the furnace "size" may be increased without actually enlarging its dimensions.

In an existing furnace, burning a given coal, there is a certain percentage of excess air that gives most economical operation. For a furnace having high stack temperature, best excess-air percentage is lower than for a furnace with low stack temperature, For the majority of furnaces, best results follow setting excess air to give a trace of CO in flue gas.

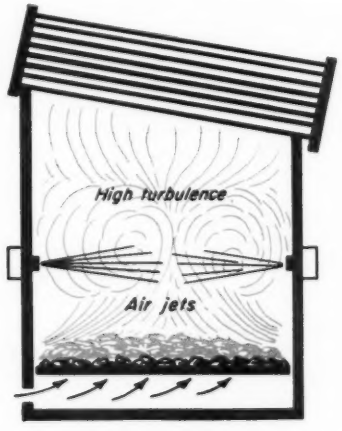
Here we have given some of the fundamentals of fuel burning. Following pages will cover the sources and properties of commercial fuels, practical aspects of their firing in various kinds of equipment, and something of the problem of selecting them.



Simplified fuel bed shows four zones



Poor mixing over the fire may be . . .



. . . overcome by high-velocity jets

TABLE I — PROPERTIES OF FUEL GASES

Fuel	Source	Average composition	High heat value, Btu/cu ft	Remarks
Blast-furnace gas	Byproduct of iron making	58% N_2 27% CO, 12% CO_2, 2% H_2, some CH_4	90-100	Good fuel when cleaned — used mainly at source
Butane	Byproduct of gasoline making, also in casing-head gas	C_4H_{10} (usually has some butylene C_4H_8 and propane C_3H_8)	3200-3260	Liquefies under slight pressure, sold as liquid (bottled gas)
Casing-head gas	Oil wells	Varies, mostly butane, propane	1200-2000	Used mostly in oil fields
Carbureted water gas	Manufactured from coal, enriched with oil vapor	34% H_2, 32% CO, 16% CH_4, 7% N_2, 5% C_2H_4, 4% CO_2, 2% C_6H_6	500-600	Good fuel, but usually costly Part of most city gas
Coke-oven gas	Byproduct coke ovens	48% H_2, 32% CH_4, 8% N_2, 6% CO, 3% C_2H_4, 2% CO_2, 1% O_2	500-600	Good fuel when cleaned, often used at source
Natural gas	Gas wells	Varies, mostly CH_4, C_2H_6, C_3H_8	950-1150	Ideal fuel, piped to point of use
Oil gas	Manufactured from petroleum	54% H_2, 27% CH_4, 10% CO, 3% N_2, 3% CO_2, 3% C_2H_4	500-550	Used on West Coast, often mixed with coke-oven gas
Producer gas	Manufactured from coal, coke, wood, etc.	51% N_2, 25% CO, 16% H_2, 6% CO_2, 2% CH_4	135-165	Requires cleaning
Propane	Byproduct of gasoline	C_3H_8	2500	Similar to butane
Refinery gas	Byproduct of petroleum processing	Varies, mostly butane, and propane	1200-2000	Used mainly at refineries
Sewage gas	Sewage-disposal plants	65% CH_4, 30% CO_2, 2% H_2, 3% N_2, traces of O_2, CO, H_2S	600-700	Many disposal plants meet all power needs with this fuel

TABLE II — OIL MEASUREMENTS AT 60 F

Gravity, deg API	Specific gravity	Lb per gal	Btu per lb	Btu per gal	Lb per 42-gal barrel	Weight, lb per cu ft
3	1.0520	8.76	18,190	159,340	368.00	65.54
4	1.0443	8.69	18,240	158,500	365.31	65.07
5	1.0366	8.63	18,290	157,840	362.62	64.59
6	1.0291	8.57	18,340	157,170	359.98	64.12
7	1.0217	8.50	18,390	156,320	357.37	63.65
8	1.0143	8.44	18,440	155,340	354.81	63.19
9	1.0071	8.39	18,490	155,130	352.46	62.78
10	1.0000	8.33	18,540	154,620	350.15	62.36
11	0.9930	8.27	18,590	153,740	347.71	61.93
12	0.9861	8.22	18,640	153,220	345.28	61.50
13	0.9792	8.16	18,690	152,510	342.88	61.07
14	0.9725	8.10	18,740	151,790	340.53	60.65
15	0.9659	8.05	18,790	151,260	338.22	60.24
16	0.9593	7.99	18,840	150,530	335.91	59.83
17	0.9529	7.94	18,890	149,980	333.64	59.42
18	0.9465	7.89	18,930	149,360	331.42	59.03
19	0.9402	7.83	18,980	148,610	329.23	58.64
20	0.9340	7.78	19,020	147,980	327.05	58.25
21	0.9279	7.73	19,060	147,330	324.91	57.87
22	0.9218	7.68	19,110	146,760	322.81	57.49
23	0.9159	7.63	19,150	146,110	320.71	57.12
24	0.9100	7.58	19,190	145,460	318.65	56.75
25	0.9042	7.53	19,230	144,800	316.59	56.39
26	0.8984	7.49	19,270	144,330	314.58	56.03
27	0.8927	7.44	19,310	143,670	312.60	55.68
28	0.8871	7.39	19,350	142,990	310.63	55.32
29	0.8816	7.35	19,380	142,440	308.70	54.98
30	0.8762	7.30	19,420	141,770	306.81	54.64
31	0.8708	7.26	19,450	141,210	304.92	54.31
32	0.8654	7.21	19,490	140,520	303.03	53.97
33	0.8602	7.17	19,520	139,960	301.18	53.64
34	0.8550	7.12	19,560	139,270	299.37	53.32
35	0.8498	7.08	19,590	138,690	297.57	53.00
36	0.8448	7.04	19,620	138,120	295.80	52.68
37	0.8398	7.00	19,650	137,550	294.04	52.37
38	0.8348	6.96	19,680	136,970	292.32	52.06
39	0.8299	6.92	19,720	136,400	290.64	51.76
40	0.8251	6.87	19,750	135,680	288.91	51.46
41	0.8203	6.83	19,780	135,090	287.23	51.16
42	0.8156	6.79	19,810	134,510	285.55	50.86

Facts About Fuels

With the fundamentals of combustion under our belts, we now need to know more about commercial fuels: where they come from, what their characteristics are, how their properties are measured. Let's take gases first.

GAS

Of many gaseous fuels, only natural gas has any commercial importance in steam generation because manufactured gases run too high in cost. Usually byproduct gases have low heating values and are produced in relatively minor quantities. So they are ordinarily used at the production point and not distributed.

Natural Gas. The origin is not known but it is often found associated with oil, and the two fuels are believed to have a common source. Natural gas is produced in more than 30 states and widespread pipeline networks make it available in some part of nearly every state (see map, next page).

Natural gas is colorless and odorless. Composition varies with source, but methane (CH_4) is always the major constituent. Most natural gas contains some ethane (C_2H_6) and a small amount of nitrogen. Gas from some areas, often called "sour" gas, contains hydrogen sulphide and organic sulphur vapors. Heating value averages about 1000 Btu per cu ft (20,000 Btu per lb) but may run considerably higher. Natural gas is usually sold by the cu ft, but may be sold by the *therm*, which is 100,000 Btu.

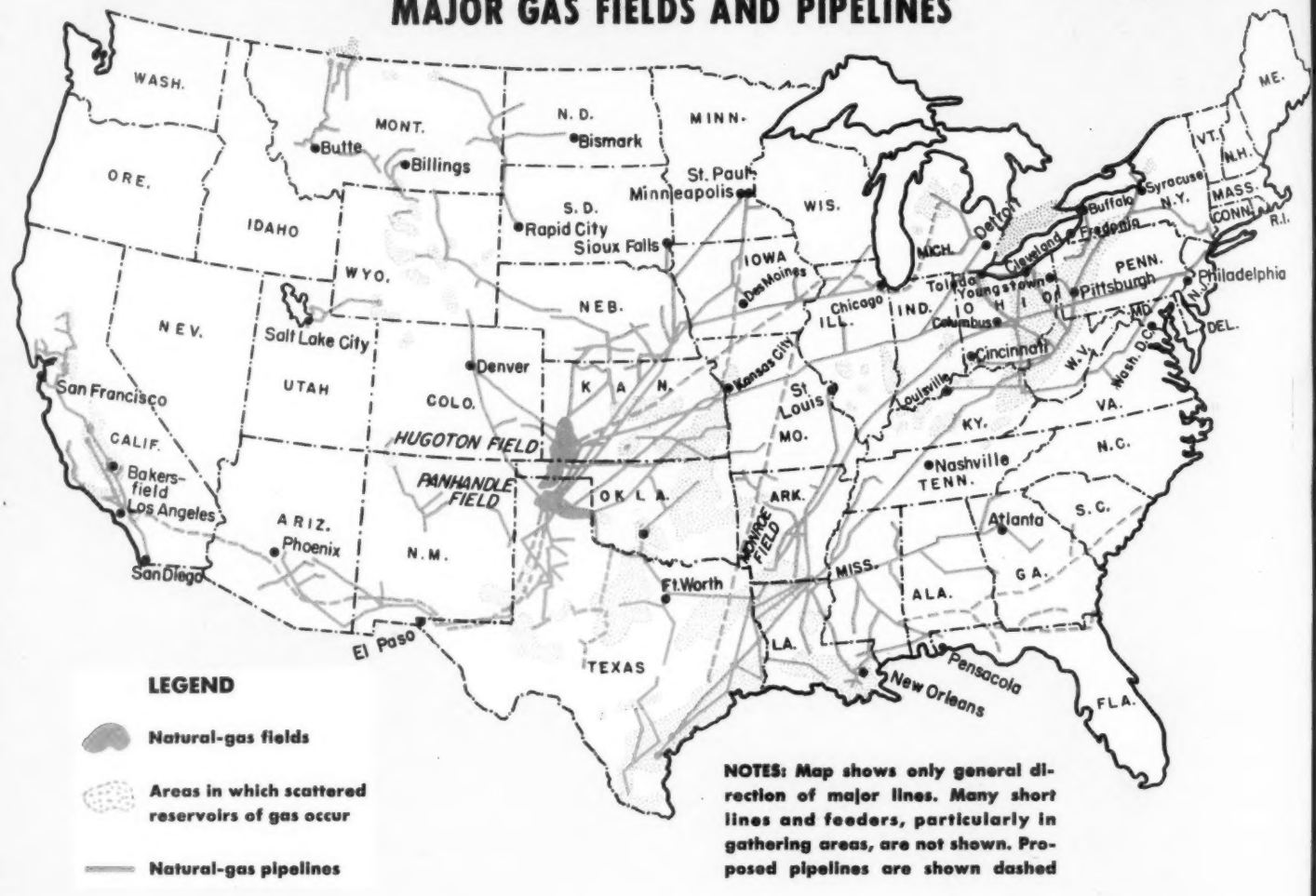
Manufactured Gases. *Coal gas* and *coke-oven gas* are produced by carbonizing high-volatile bituminous coal in retorts that exclude air and are heated externally by producer gas. Usually a number of byproducts result. Cleaned of impurities, these gases are roughly one-half hydrogen and one-third methane, plus small amounts of carbon monoxide, carbon dioxide, nitrogen, oxygen and illuminants (C_2H_4 and C_6H_6). Heating value runs around 550 Btu per cu ft.

The term *water gas* generally refers to a mixture of carbon monoxide, hydrogen and nitrogen obtained by passing steam and air alternately through a bed of incandescent carbon. Heating value averages less than 300 Btu per cu ft. This gas may be enriched by *carbureting* with oil, which is converted into a permanent gas and mixed with the water gas. This increases heating value to about 550 Btu per cu ft.

Where oil is cheap, *oil gas* may be made. Like coal gas, this runs about one-half hydrogen and one-third methane for about 550 Btu.

The manufactured gases described are those commonly distributed. The gas served in a given area may be a mixture of two or more of them, or a mixture of natural and manufactured gas. Heating value, usually held to 525-550 Btu per cu ft, is often fixed by state or local ordinance.

Although it is a manufactured gas, the low heating value of *producer gas* (125-150 Btu per cu ft) makes it uneconomical to distribute it. It is made by firing coal with an air supply insufficient for complete combustion, either with or without admixture of steam. It runs about one-half nitrogen, one-quarter carbon monoxide, and one-



sixth hydrogen. Fuels other than coal may be used; in many parts of the world producer gas is made from waste.

Byproduct Gases. Commercial *butane* and *propane* are essentially byproducts of manufacture of natural gasoline and of certain refinery operations. As supplied, propane (C_3H_8) is essentially pure, while butane (C_4H_{10}) usually contains a small amount of propane. Both have high heating values, are easily liquefied at low pressure. They are widely used as "bottled" fuels.

Blast-furnace gas, a byproduct of iron-making, has the lowest heating value of any commercial gas, about 90 Btu per cu ft. It is close to three-quarters nitrogen and carbon dioxide, the only important combustible constituent being carbon monoxide. Raw gas, which usually contains a high concentration of solid impurities, is normally washed before use. Unwashed gas, however, has been successfully burned in boiler furnaces (POWER, Nov 1938, pp 588-591).

In recent years, use of gas produced by digesting sewage sludge has become common practice in disposal plants. *Sewage gas,* or *sewage-sludge gas,* runs about two-thirds methane and one-third carbon dioxide, with small amounts of hydrogen, nitrogen and usually some hydrogen sulphide. Heating value is about 650 Btu per cu ft. Although mostly used in engines, this gas is also burner fired.

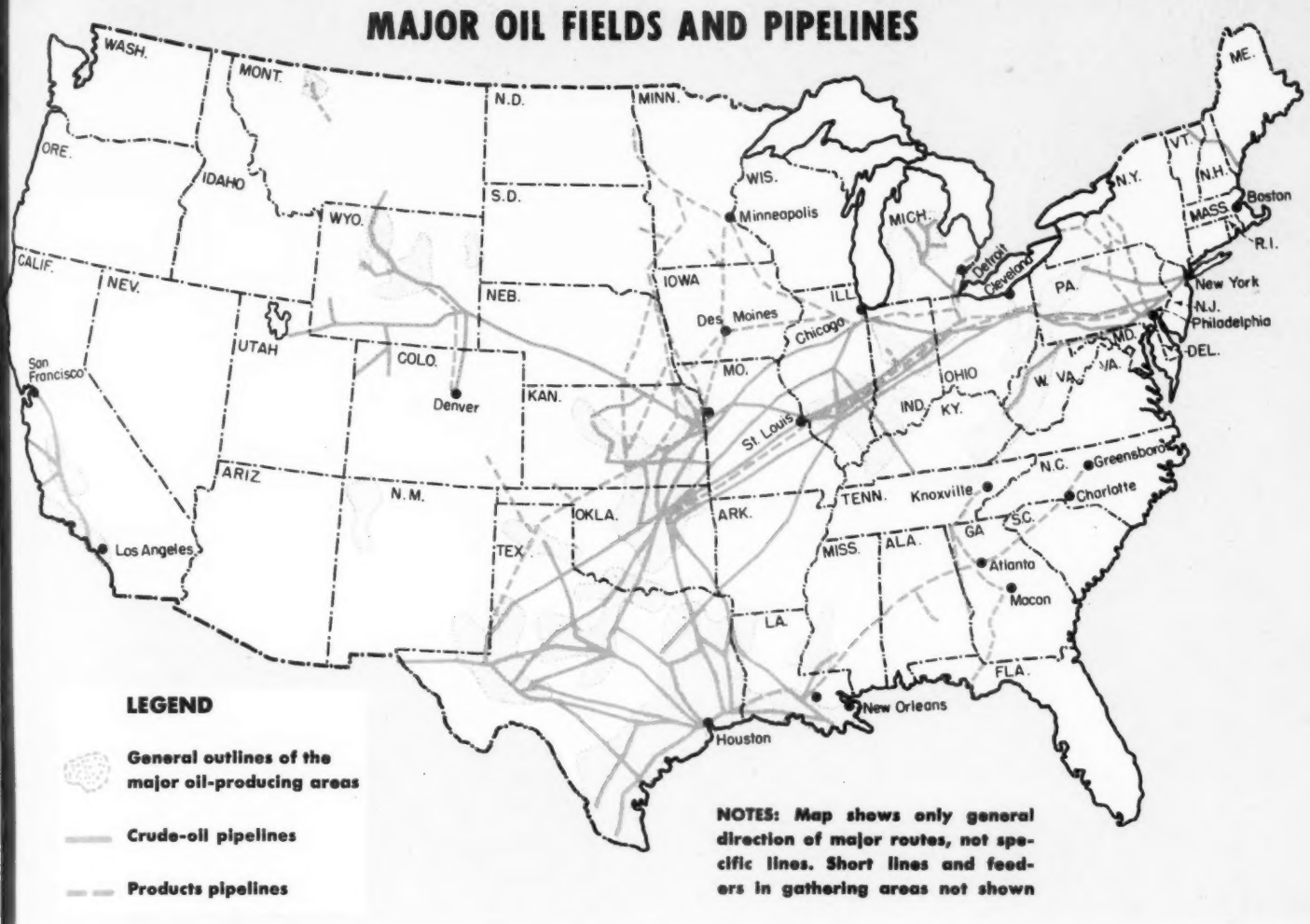
OIL

Petroleum and its byproducts furnish practically all commercially used liquid fuels. Geologists believe decomposition of minute marine growths or possibly, at times, of vegetable matter formed the oil that lies trapped in pools between layers of the earth's crust. This *crude oil* consists of 83-87% carbon and 10-14% hydrogen, plus traces of oxygen, nitrogen and sulphur. The hydrogen and carbon are combined as *hydrocarbons.*

Crude oil moves from well to refinery mainly by pipeline and tanker. Although virtually every state boasts some refining capacity, ten have almost 90% of the nation's total. Fuel oils move from refineries to nearby markets by truck, tank car and barge, with tankers serving seaboard areas.

Refining Processes. Since practically all liquid fuels are either products or byproducts of refining, the way they are made has more to do with their fuel qualities than the source of the crude. Refining consists of separating and, usually, recombining the hydrocarbons of the fuel oil into specialized products like gasoline, fuel oil, etc. Basic process is simple distillation, which separates the hydrocarbons into groups or "fractions" having the same range of boiling points. From light to heavy, typical fractions are: (1) naphtha (2) gasoline (3) kerosene, and (4) gas oil. These are the *distillates;* the remainder, or *residual,* is a heavy fuel oil. Products of simple distillation are called *straight-run.*

Simple distillation is sometimes the whole story, but in modern refining it is only the beginning. To secure greater gasoline yields, fractions heavier than gasoline are usually *cracked,* that is, decomposed by heat and pressure, with or without a catalyst. Of the new hydrocarbons resulting, some are lighter and some heavier; these are likewise separated according to boiling range. Cracking, unlike simple distillation, actually changes the hydrocarbon structure so crude oil yields more valuable lighter hydrocarbons (gasoline) and proportionately less heavy ones.



Commercial Fuel Oils. Fuel oils used commercially may be either distillates or residuals, and either straight run or cracked. Straight-run products become increasingly less common as refinery practice leans more heavily on cracking, and are, in general, premium grades. Thus the great bulk of commercial fuel oils are cracked products; distillates form the source for lighter grades used in domestic and some commercial and industrial burners, whereas residuals supply the heavy oils for larger commercial and industrial units.

Refinery wastes, which have little or no commercial value, are usually burned at the refinery or in adjacent plants. They include acid sludge, tars and tank cleanings or "bottoms."

Specific Gravity. Since hydrogen has a much higher heating value and lower atomic weight than the other principal element in fuel oil, it's easy to see that the proportions of carbon and hydrogen affect both specific gravity and heating value. Because of this, specific gravity forms a reliable guide to an oil's heating value (see table on p 77).

Specific gravity in *degrees API* (American Petroleum Institute) is found by dividing *specific gravity with respect to water* (at 60 F) into 141.5 and subtracting 131.5 from the answer. Gravity in *degrees Baume* is found in the same way except the numbers are 140 and 130, respectively. For practical engineering work, the two gravity scales may be considered the same.

Viscosity. The relative ease or difficulty with which an oil flows is its *viscosity*. It is measured by the time in seconds a standard amount of oil takes to flow through a standard orifice in a device called a viscosimeter. The usual standard in this country is the *Saybolt Universal,* or the *Saybolt Furol,* for oils of high viscosity. Since viscosity changes with temperature, tests must be made at a standard temperature, usually 100 F for Saybolt Universal and 122 F for Furol.

Viscosity indicates how oil behaves when pumped and, more particularly, shows when preheating is required and what temperature must be held.

Flash and Pour. *Flashpoint* represents the temperature at which an oil gives off enough vapor to make an inflammable mixture with air. Results of a flashpoint test depend on the apparatus, so this is specified as well as temperature. Flashpoint measures oil's volatility and indicates maximum temperature for safe handling.

Pour point represents lowest temperature at which an oil flows under standard conditions. Including pour point in a specification insures that an oil will not give handling trouble at expected low temperature.

By centrifuging a sample of oil, amount of *water and sediment* can be found. These are impurities and while it is not economical to eliminate them, they should not occur in excessive quantities (not more than 2%). Incombustible impurities in oil, from natural salts, from chemicals in refining operations, or from rust and scale picked up in transit, show up as *ash.* Some ash-producing impurities cause rapid wear of refractories and some are abrasive to pumps, valves and burner parts. In the furnace, they may form slag coatings.

All tests above are covered by ASTM standards, which should be consulted for details of apparatus and methods (*ASTM Standards on Petroleum Products and Lubricants,* American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.).

Fuel oils have a tendency to deposit

COAL FIELDS OF THE UNITED STATES
WASH.
ROSLYN FIELD
ASSINNIBOINE REGION
MONT.
GREAT FALLS FIELD
JUDITH BASIN REGION
MISSOURA FIELD
TURTLE MT. FIELD
FORT UNION REGION
N. D.
IDAHO
LEWISTOWN FIELD
TRAIL CREEK FIELD
BURL MT. FIELD
YELLOWSTONE REGION
COOS BAY FIELD
EDEN RIDGE FIELD
ORE.
RED LODGE FIELD
MINN.
LAKE SUPERIOR
MICH.
LAKE MICHIGAN
LAKE HURON
ELECTRIC FIELD
BIGHORN BASIN REGION
POWDER RIVER REGION
BLACK HILLS REGION
CAMBRIA FIELD
S. D.
WYO.
ST. ANTHONY FIELD
CALIF.
GOOSE CREEK FIELD
WIS.
NORTHERN REGION
LAKE ONTARIO
LAKE ERIE
N.Y.
PENNSYLVANIA ANTHRACITE REGION
WESTERN MIDDLE FIELD
NORTHERN FIELD
VT.
ME.
N.H.
MASS.
RHODE ISLAND ANTHRACITE REGION
CONN.
R.I.
EASTERN MIDDLE FIELD
SOUTHERN FIELD
N.J.
DEL.
MD.
PA.
BROAD TOP FIELD
GEORGES CREEK FIELD
UPPER POTOMAC FIELD
NEW RIVER FIELD
POCAHONTAS FIELD
TAZEWELL FIELD
RICHMOND FIELD
VA.
W. VA.
APPALACHIAN REGION
BRUSHY MT. FIELD
ATLANTIC COAST
DEEP RIVER FIELD
N.C.
S.C.
GA.
FLA.
SAND MT. FIELD
LOOKOUT MT. FIELD
WARRIOR FIELD
COOSA FIELD
CAHABA FIELD
MISS.
ALA.
LA.
TEXAS REGION
MISSISSIPPI REGION
ARK.
TENN.
KY.
ILL.
IND.
OHIO
WINDBER FIELD
CONNELLSVILLE FIELD
IOWA
WESTERN REGION
EASTERN REGION
MO.
KAN.
OKLA.
TEXAS
SOUTHWESTERN REGION
NEB.
COLO.
DENVER REGION
SOUTH PARK FIELD
CANON CITY FIELD
TRINIDAD FIELD
RATON MESA REGION
RATON FIELD
HANNA FIELD
WIND RIVER REGION
ROCK CREEK FIELD
NORTH PARK FIELD
CASTLE GATE FIELD
BLACKTAIL FIELD
COALVILLE FIELD
UINTA REGION
GREEN RIVER REGION
ROCK SPRINGS FIELD
HAMS FORK
EMERY FIELD
CRESTED BUTTE FIELD
SOUTHWESTERN UTAH REGION
COLOB PLATEAU FIELD
HENRY MTS. FIELD
KAIPAROWITS PLATEAU FIELD
BLACK MESA FIELD
SAN JUAN RIVER REGION
NEV.
STONE CANYON FIELD
UTAH
ARIZ.
N. M.
GALLUP FIELD
CERRILLOS FIELD
DATIL MT. FIELD
CARTHAGE FIELD
CAPITAN FIELD
DEER CREEK FIELD
LEGEND
Anthracite
Low-volatile
Bituminous (12,500 Btu. or more, on air-dried sample)
Bituminous (less than 12,500 Btu on air-dried sample)
Subbituminous
Lignite
COAL-FIELDS AND PRODUCING DISTRICTS
Boundaries of producing districts defined in Bituminous Coal Act of 1937
Producing district numbers
State boundaries
Coal-fields shown include (1) areas of known commercial value; (2) areas underlain by coal-bearing formations in which little coal is known, and (3) areas containing thin coal beds which locally may be thick enough to work.

sludge in storage; this may be aggravated by mixing oils of different character as when deliveries from two sources go into the same tank. These simple rules avoid trouble when oils are mixed: (1) Straight-run residuals can be mixed with any straight-run product, and cracked residuals with straight-run residual (2) cracked distillate can be added as a third constituent, but (3) cracked residual *cannot* be added to straight-run distillate.

COAL

Three-hundred-million years ago, in swamp forests of the Carboniferous Age, the foundation of our present reserves was laid. For 50 million years, giant trees and ferns grew and fell, to decay and form rich peat bogs. Floods buried the bogs under layers of sediment, only to subside and permit the growth-and-decay cycle to begin again. As millions of years passed, pressure, heat and time worked to drive off some volatile matter, to harden the mass, and to turn it into the carbon-substance we call coal.

Different kinds contain different amounts of carbon substance depending on the age of the deposit and the conditions under which it formed. Next to the original peat, the "youngest" form is *lignite,* high in moisture and low in fixed carbon. Older coals, higher in "rank," contain more fixed carbon.

Analyses. Various tests and methods of analysis express coal qualities in figures instead of words. Principal characteristics are expressed in what is known as a *proximate analysis,* as distinguished from an *ultimate analysis,* which shows the exact chemical composition of a fuel, without paying any attention to the physical form in which the compounds appear. As we have seen, this gives data needed for combustion calculations.

For a better picture of coal's behavior in a furnace, the proximate analysis determines the percentage of (1) *moisture* (2) *ash* (3) *volatile matter* and (4) *fixed carbon.* These percentages add up to 100. In addition, it is customary to determine: (1) total amount of *sulphur,* as a separate percentage (2) *ash-fusion temperature,* and (3) heating value.

Reporting Analyses. There are five ways to report an analysis, although only the first three are likely to be met in power-plant work: (1) as received (2) air dried (3) moisture free (4) moisture and ash free, and (5) moisture and mineral free. As the name implies, the as-received analysis reports the condition of coal as delivered to the laboratory. This comes closest to giving the conditions *as shipped* or *as fired,* the values desired in practical work. Loss or gain of moisture between time of sampling and analysis depends on the kind of coal, size, weather conditions, and method of handling sample.

Following paragraphs discuss the various characteristics of coal (those reported in proximate analyses and others) and how they affect the value of coal in power-plant operation. For details on equipment and procedures for testing coal, consult *ASTM Standards on Coal and Coke* (1948).

Moisture. All coal contains some natural moisture (1 to 5% in Eastern coals and up to 40% in some lignites). This *inherent* moisture lies in the pores and forms a true part of the coal, being retained when it is air dried. *Surface* moisture depends on conditions in the mine, and during transit.

Moisture must be transported, handled and stored; its presence in large amounts increases cost and difficulty of these operations. Looked at another way, moisture replaces an equal amount of combustible material and thus decreases the heat content per lb. In addition, some heat liberated in the furnace goes to evaporating moisture in the fuel and superheating the vapor; this *moisture* loss can be figured from the chart on page 117.

MINERAL IMPURITIES

Ash. This incombustible mineral matter, left behind when coal burns completely, differs from "ashes," as the power-plant man knows them, because ashes taken from a furnace always contain some unburned coal.

Like moisture, ash is an impurity that increases shipping and handling costs. It must be removed from the furnace and the plant, usually requiring additional equipment and expense. Recent research shows that amount and character of ash constitutes the biggest single factor in fuel-bed and furnace problems like clinkering and slagging. An increase in ash content usually means an increase in carbon carried to the ashpit.

Volatile Matter. In a way not yet clearly known, coal holds combustible gases such as methane and other hydrocarbons, hydrogen and carbon monoxide, and incombustible gases like carbon dioxide and nitrogen. Heat releases these gases.

Percentage of volatile matter indicates the amount of gaseous fuel present and thus bears a direct relationship to firing mechanics. It affects furnace volume and arrangement of heating surfaces.

Fixed Carbon. When the volatile matter distills off, a solid fuel is left, consisting, in the main, of carbon, but containing some hydrogen, oxygen, sulphur and nitrogen not driven off with the gases. Subtracting percentage of moisture, ash and volatile matter from 100% yields a percentage called fixed carbon.

Sulphur. Although it burns, sulphur in coal is an undesirable element for power-plant use. It plays a part in clinkering and slagging, in corrosion of air heaters, economizers, breeching and stacks, and in spontaneous combustion of stored coal. It occurs mainly as iron sulphide (commonly known as pyrites), as organic sulphur, and in small amounts as sulphates. Only total sulphur is measured, although it is known that iron combined with the sulphur shares the blame for troubles laid to sulphur.

Ash Fusion. Temperature at which ash fuses is measured by heating cones of ash in a furnace arranged to produce a reducing atmosphere. Temperature at which the cone fuses down to a round lump is called *softening* or *ash-fusion temperature.* Other temperatures sometimes observed include that at which (1) cone tip starts to bend (*initial deformation temperature*) and (2) cone spreads out in a flat layer (*fluid*).

Ash-fusion temperature (and sometimes the spread between initial and softening, or softening and fluid temperatures) serves as the best single indicator of clinkering and slagging tendencies under given fuel-bed and furnace conditions.

Heating Value. If a coal sample is burned in a "bomb" calorimeter filled with oxygen under pressure, the higher heating value is measured. The consumer buys energy units when he buys fuel, and so the heating value plays a basic part in judging fuel values. Sometimes heating value of fuel may affect maximum capacity of a plant.

PULVERIZING QUALITIES

Grindability. Wide use of pulverized-fuel firing brought a need for tests to show the relative ease or difficulty of grinding different kinds of coal. ASTM tentatively approves two methods, *ball-mill* and *Hardgrove.* The first measures relative amounts of energy needed to pulverize different coals by finding the number of ball-mill revolutions needed to grind a sample so 80% passes a 200-mesh sieve (74 microns). The *ball-mill grindability index,* in percent, is found by dividing number of revolutions into 50,000.

In the Hardgrove test, a prepared sample receives a definite amount of grinding energy in a miniature pulverizer; results are measured by weighing amount passing a 200-mesh sieve. Multiplying weight passing the sieve by 6.93 and adding 13 to the product gives *Hardgrove grindability.*

Grindability values do not give a direct comparison of pulverizer capac-

SPECIMEN ANALYSES OF TYPICAL COALS

Bed or Seam	State	County	%M	%V	% FC	% Ash	% S	Htg val, Btu/lb	Ash-fusion temp, F	HG
District 1:										
Barton	Md.	Allegany	2.5	15.8	68.3	13.4	2.1	13,020	.....	
Brookville	Pa.	Somerset	4.3	18.0	69.0	8.7	1.2	13,340	.....	
		Jefferson	2.8	34.4	52.1	10.7	3.1	13,040	.....	
Clarion	Pa.	Fulton	1.5	15.2	74.8	8.5	1.2	14,100	.....	
		Clarion	3.7	38.6	49.2	8.5	3.6	13,140	.....	
Elk Lick	W. Va.	Mineral	1.6	16.7	66.6	15.1	3.4	12,820	.....	
L Freeport	Pa.	Somerset	3.2	17.4	70.8	8.6	1.1	13,790	2500–2900	
		Elk	2.8	32.8	58.4	6.0	2.0	14,120	.....	
L Kittanning	Md.	Garrett	2.7	22.3	63.5	11.5	3.4	13,370	.....	
L Kittanning	Pa.	Lycoming	4.1	15.9	65.3	14.7	0.5	12,320	.....	
		Clarion	3.3	37.1	51.5	8.1	3.2	13,330	.....	47
L Sewickley	Md.	Allegany	2.8	19.6	69.8	7.8	1.1	13,910	2700–2900	
M Kittanning	Pa.	Somerset	4.2	16.1	68.9	10.8	1.7	13,230	.....	
		Elk	2.4	29.8	51.1	16.7	1.9	12,170	.....	
Mahoning	W. Va.	Mineral	3.0	14.2	70.8	12.0	1.6	13,230	.....	
Pittsburgh	Md.	Allegany	2.5	18.2	70.5	8.8	0.9	13,860	2700–3000	
Sewickley	Pa.	Somerset	3.0	20.7	67.0	9.3	1.4	13,700	.....	
U Freeport	Md.	Allegany	2.3	19.3	66.2	12.2	2.8	13,250	.....	
U Freeport	Pa.	Bedford	1.1	16.4	70.8	11.7	2.1	13,630	.....	
		Armstrong	3.1	33.9	54.5	8.5	2.2	13,360	2100–2600	57
U Freeport	W. Va.	Mineral	2.0	15.2	70.6	12.2	3.6	13,270	.....	
		Tucker	2.8	24.0	65.3	7.9	1.2	13,960	.....	
U Kittanning	Md.	Allegany	3.0	14.4	69.6	13.0	1.3	13,090	.....	
		Clarion	3.0	38.1	50.0	8.9	5.5	13,230	.....	
District 2:										
Brookville	Pa.	Butler	3.7	37.0	52.4	6.9	1.6	13,550	.....	
L Freeport	Pa.	Butler	3.1	35.0	55.2	6.7	1.1	13,710	.....	
L Kittanning	Pa.	Armstrong	2.3	38.6	51.7	7.4	2.9	13,570	.....	
Pittsburgh	Pa.	E. Westmorel'd.	3.0	24.2	61.6	11.2	1.3	13,340	2600–2900	
		Washington	3.0	35.7	54.4	6.9	1.2	13,710	2100–2600	60
Redstone	Pa.	Allegheny	3.5	32.6	52.9	11.0	1.8	12,840	.....	
Sewickley	Pa.	Fayette	2.5	34.0	52.1	11.4	3.1	13,020	2200–2500	
U Freeport	Pa.	Butler	3.0	34.2	53.5	9.3	1.5	13,290	2100–2700	
U Kittanning	Pa.	Butler	3.4	34.7	54.8	7.1	2.0	13,510	.....	
Waynesburg	Pa.	Greene	3.4	34.1	46.9	15.6	3.2	12,030	.....	
District 3:										
Bakerstown	W. Va.	Preston	2.0	28.9	61.4	7.7	1.8	14,010	2200–2500	
L Kittanning	W. Va.	Randolph	2.5	29.5	57.4	10.6	1.3	13,410	2600–3000	51
		Preston	2.5	22.9	64.3	10.3	1.8	13,450	2400–2700	101
Peerless	W. Va.	Webster	2.1	36.3	59.1	2.5	0.7	14,800	.....	
Pittsburgh	W. Va.	Taylor	2.0	37.8	52.8	7.4	2.5	13,890	2000–2200	71
Redstone	W. Va.	Upshur	2.6	36.3	54.1	7.0	1.7	13,650	.....	
Sewell	W. Va.	Randolph	3.3	28.8	61.9	6.0	0.8	14,060	2500–2900	
Sewickley	W. Va.	Monongalia	2.0	35.6	51.0	11.4	2.5	13,080	2100–2400	
U Freeport	W. Va.	Preston	2.5	29.1	57.9	10.5	1.6	13,410	2200–2800	63
	W. Va.	Upshur	1.5	38.0	50.7	9.8	1.4	13,550	.....	
District 4:										
Clarion	Ohio	Vinton	5.5	39.6	41.9	13.0	3.7	11,690	.....	
L Freeport	Ohio	Jefferson	3.8	37.6	49.8	8.8	2.8	13,050	.....	
L Kittanning	Ohio	Lawrence	7.3	37.8	45.1	9.8	1.6	11,880	.....	51
M Kittanning	Ohio	Perry	7.8	36.0	47.3	8.9	2.0	11,900	2200–2700	
		Coshocton	5.9	41.6	44.2	8.3	3.8	12,470	.....	
Pittsburgh	Ohio	Jefferson	4.5	36.8	49.6	9.1	3.0	12,740	2100–2200	58
		Belmont	3.8	40.3	47.2	8.7	3.9	12,940	1900–2100	
Sharon	Ohio	Jackson	12.0	30.1	43.3	14.6	0.4	10,280	.....	
U Freeport	Ohio	Athens	5.1	37.3	50.8	6.8	2.8	12,590	.....	
District 5:										
	Mich.	Bay	12.1	34.0	47.5	6.4	1.2	11,930	.....	
		Calhoun	11.2	40.1	40.2	8.5	6.3	11,510	.....	
		Midland	13.1	33.3	46.6	7.0	2.2	11,510	.....	
		Saginaw	11.1	34.9	48.2	5.8	1.6	12,140	.....	50–60
		Shiawassee	11.7	36.3	42.5	9.5	2.7	11,640	.....	
District 6:										
Pittsburgh	W. Va.	Brooke	4.0	36.9	50.6	8.5	2.7	12,920	2000–2200	
		Hancock	5.9	35.5	49.6	9.0	2.3	12,550	.....	
		Marshall	2.9	40.5	47.8	8.8	4.4	13,140	.....	
		Ohio	3.5	39.5	48.7	8.3	4.2	13,030	2000–2200	
District 7:										
Beckley	W. Va.	Raleigh	2.7	17.1	74.8	5.4	0.7	14,390	2500–3000	107
Big Eagle	W. Va.	McDowell	3.0	29.2	62.0	5.8	0.8	14,150	.....	69
Campbell Creek	W. Va.	Fayette	2.6	32.6	59.4	5.4	1.2	14,070	2400–2800	
Coalburg	W. Va.	Fayette	1.8	34.4	58.0	5.8	0.7	14,050	.....	
Eagle	W. Va.	Fayette	2.5	29.7	62.3	5.5	0.6	14,360	2400–3000	75
Fire Creek	W. Va.	Raleigh	2.7	16.4	74.7	6.2	1.0	14,260	2400–2800	
Jewell	Va.	Buchanan	2.6	20.8	73.2	3.4	0.5	14,870	.....	
Merrimac	Va.	Montgomery	2.4	11.5	66.7	19.4	0.6	12,000	2400–3000	
Pocahontas No. 3	Va.	Tazewell	3.2	19.9	72.5	4.4	0.6	14,570	2200–2600	103
Pocahontas No. 3	W. Va.	McDowell	2.7	17.6	73.7	6.0	0.7	14,440	2200–2700	103
	W. Va.	Raleigh	2.6	16.4	74.1	6.9	0.7	14,210	2600–2900	
Pocahontas No. 4	W. Va.	McDowell	1.9	15.9	75.4	6.8	0.5	14,370	2100–2400	91
Pocahontas No. 5	Va.	Tazewell	3.4	21.0	69.4	6.2	0.5	14,200	.....	99
Pocahontas No. 6	W. Va.	Wyoming	2.0	17.9	74.6	5.5	0.6	14,520	2500–2900	101
		Greenbrier	3.0	22.6	68.6	5.8	0.5	14,350	.....	
Powelliton	W. Va.	Fayette	3.1	32.0	59.4	5.5	0.7	14,130	.....	61–67
Red Ash	W. Va.	McDowell	1.5	23.8	70.0	4.7	0.8	14,890	.....	
Sewell	W. Va.	McDowell	3.0	18.1	72.9	6.0	0.6	14,300	2400–2600	
		Greenbrier	3.1	25.0	66.8	5.1	1.3	14,290	2200–2500	87–99
Welch	W. Va.	McDowell	2.5	18.2	72.2	7.1	0.5	14,180	2500–2900	
District 8:										
Big Eagle	W. Va.	McDowell	2.9	31.2	59.6	6.3	1.8	14,050	.....	69
Big Mary	Tenn.	Anderson	2.5	36.8	51.6	9.1	3.3	13,230	2200–2500	
Blair	Va.	Wise	2.9	32.7	58.7	5.7	0.9	14,060	.....	78
Campbell Creek	W. Va.	Fayette	2.5	34.7	56.5	6.3	1.0	14,000	2400–2600	
Cedar Grove	W. Va.	Logan	2.0	35.7	56.0	6.3	1.6	13,950	2300–2900	
Chilton	W. Va.	Logan	2.5	34.4	56.9	6.2	0.7	13,910	2500–2900	59
Clintwood	Va.	Buchanan	2.5	31.3	59.6	6.6	1.1	14,110	2600–3000	58–65
Coalburg	W. Va.	Kanawha	3.5	34.2	54.9	7.4	0.8	13,470	.....	39–47
Coal Creek	Tenn.	Anderson	2.0	38.3	55.3	6.4	1.2	13,910	2200–2500	
		Morgan	2.0	39.0	51.9	7.1	3.9	13,860	2000–2200	
Dean	Ky.	Knox	4.0	36.0	52.7	7.3	0.9	13,150	2600–2900	
Deep River	N. C.	Lee	2.0	32.1	58.3	7.6	2.5	13,750	.....	
		Moore	3.7	15.9	57.9	22.5	3.0	11,280	.....	
Eagle	W. Va.	Logan	2.5	32.7	58.6	6.2	0.8	13,980	2600–2900	45–67
Elkhorn	Ky.	Letcher	3.0	36.4	57.3	3.3	0.5	14,170	2200–2600	46–53
Fire Clay No. 4	Ky.	Perry	3.5	37.3	54.8	4.4	0.8	13,820	2300–2800	
Harlan	Ky.	Harlan	2.5	37.1	55.8	4.6	0.8	14,000	2300–2800	48–58
Hazard No. 4	Ky.	Breathitt	5.6	34.0	53.3	7.1	1.0	12,960	.....	
Hazard No. 6	Ky.	Perry	4.8	35.2	53.0	7.0	0.6	13,090	2900–	43–53
Hazard No. 7	Ky.	Perry	4.3	35.7	54.1	5.9	0.6	13,430	2800–3000	44–54
Hernshaw	W. Va.	Boone	3.0	34.6	57.3	5.1	0.9	14,160	.....	51
High Splint	Ky.	Harlan	4.0	37.6	53.7	4.7	0.7	13,500	2300–2700	31
Hooper	Tenn.	Morgan	2.6	37.4	56.5	3.5	1.5	14,020	.....	
Imboden	Va.	Wise	2.5	34.3	56.7	6.5	0.8	13,820	2500–2900	62
Jellico	Tenn.	Campbell	4.0	36.5	54.8	4.7	1.0	13,760	2300–2800	
Keokee	Ky.	Harlan	3.0	36.9	56.6	3.5	0.7	14,120	2200–2500	
L Banner	Va.	Buchanan	2.3	22.3	67.8	7.6	1.3	14,150	2600–2800	
		Russell	2.1	36.3	55.3	6.3	0.7	14,090	.....	
L Elkhorn	Ky.	Pike	3.0	33.2	57.3	6.5	0.6	13,880	2600–3000	
L Kittanning	W. Va.	Kanawha	3.0	35.2	53.7	8.1	0.8	13,330	2500–2900	
L Sewanee	Tenn.	Cumberland	2.3	28.3	62.1	7.3	0.7	13,750	.....	
Low Splint	Va.	Lee	2.9	36.4	53.7	7.0	0.7	13,630	.....	
Mason	Ky.	Bell	3.0	37.4	55.4	4.2	1.2	13,920	2400–2600	
Norton	Va.	Wise	2.9	32.9	57.6	6.6	1.1	13,910	.....	
No. 1	Ky.	McCreary	3.1	36.3	53.0	7.6	2.6	13,300	.....	
No. 1½	Ky.	McCreary	4.0	35.6	54.1	6.3	0.6	13,330	.....	
No. 7	Ky.	Boyd	5.0	37.3	51.8	5.9	1.0	12,790	.....	
Poplar Creek	Tenn.	Campbell	3.0	36.9	55.3	4.8	1.4	13,780	.....	
Poplar Lick	Ky.	Bell	3.4	37.9	49.7	9.0	2.6	13,120	.....	
Powellton	W. Va.	Fayette	2.5	32.7	60.3	4.5	0.8	14,280	2600–2900	
Raven	Va.	Tazewell	2.8	31.7	59.7	5.8	0.5	14,240	.....	
Red Ash	Tenn.	Campbell	3.4	38.5	52.2	5.9	1.1	13,510	.....	
Sterling	Ky.	Bell	2.2	37.9	50.5	9.4	3.0	13,060	.....	
Straight Creek	Ky.	Bell	3.0	37.9	54.6	4.5	0.8	13,930	2100–2300	53
Taggart	Va.	Lee	3.3	35.7	56.6	4.4	0.6	13,960	2100–2500	
U Banner	Va.	Dickenson	2.0	30.0	62.0	6.0	0.8	14,400	2400–2800	
		Russell	2.7	35.0	55.3	7.0	0.6	13,870	2200–2500	
U Elkhorn No. 1	Ky.	Floyd	4.0	36.8	54.2	5.0	0.9	13,580	2300–2700	
U Elkhorn No. 2	Ky.	Floyd	4.4	35.9	54.6	5.1	1.1	13,530	2200–2700	51
U Elkhorn No. 3	Ky.	Pike	3.3	33.4	58.4	4.9	0.7	13,900	.....	
Wallins	Ky.	Harlan	3.1	38.1	54.3	4.5	0.7	13,840	.....	59–68
Wilder	Tenn.	Overton	3.3	35.8	50.5	10.4	2.5	12,880	2100–2400	
Windrock	Tenn.	Anderson	2.5	38.0	52.7	6.8	0.9	13,620	.....	
Winifrede	W. Va.	Mingo	3.5	36.1	53.8	6.6	0.6	13,550	2600–3000	
District No. 9:										
No. 6 (Raw)	W. Ky.	Various	6.4	36.4	51.9	5.3	1.7	12,900	2220	
No. 9 (Washed)	W. Ky.	Various	5.1	36.8	51.3	6.8	2.5	12,749	2215	65
No. 11 (Washed)	W. Ky.	Various	7.0	39.6	47.7	5.7	3.0	12,625	2210	54
No. 12 (Washed)	W. Ky.	Various	10.5	33.9	44.6	11.0	2.9	11,230	2310	56
No. 14 (Washed)	W. Ky.	Hopkins	8.0	37.6	48.0	6.4	3.0	12,400	2200–2400	
District No. 10:										
Herrin No. 6	Ill.	Christian	13.5	35.6	39.3	11.6	4.2	10,610	2000	57
		Franklin	9.5	33.0	49.0	8.5	0.8	11,900	2100–2500	56
		Fulton	17.0	34.0	42.2	6.8	2.6	10,960	.....	
		Bond	12.4	32.9	42.9	11.8	4.0	10,730	.....	
LaSalle No. 2	Ill.	Bureau	15.7	35.0	38.9	10.4	3.8	10,580	.....	
Springfield No. 5	Ill.	Peoria	14.5	34.1	39.0	12.4	3.0	10,530	.....	66
Harrisburg No. 5	Ill.	Saline	6.5	33.9	51.2	8.4	2.2	12,490	2000–2100	59
Colchester No. 2	Ill.	Henry	14.5	37.1	38.7	9.7	3.3	10,750	.....	62
Rock Island No. 1	Ill.	Knox	14.5	37.2	38.6	9.7	5.1	10,970	.....	
Danville No. 7	Ill.	Vermilion	13.3	36.6	39.0	11.1	3.6	10,940	.....	
District No. 11:										
III	Ind.	Greene	11.2	36.7	43.7	8.4	4.0	11,570	.....	
IV	Ind.	Clay	11.9	34.7	44.1	9.3	1.7	11,440	.....	
V	Ind.	Sullivan	11.8	34.1	47.6	6.5	1.3	11,850	.....	
		Warrick	10.0	37.4	43.1	9.5	3.9	11,570	2000–2200	
VI	Ind.	Sullivan	11.9	35.8	43.7	8.6	2.2	11,590	.....	
VII	Ind.	Sullivan	15.2	31.7	44.8	8.3	0.6	11,150	.....	
Brazil Block	Ind.	Clay	16.0	31.3	46.5	6.2	1.0	11,460	.....	
Semi-Block	Ind.	Greene	10.9	40.3	41.3	7.5	2.9	12,010	.....	
Minshall	Ind.	Vermilion	12.3	37.6	39.0	11.1	4.6	11,010	.....	
District No. 13:										
Clark	Ala.	Bibb	2.9	34.8	56.1	6.2	0.8	13,830	2100–2400	59
Jagger	Ala.	Fayette	3.1	33.9	52.5	10.5	0.7	12,790	.....	
Black Creek	Ala.	Jefferson	2.9	31.8	61.5	3.8	0.7	14,410	2500–2800	64–70
Black Creek	Ala.	Marion	5.1	37.3	54.4	3.2	1.4	13,640	.....	45
Helena	Ala.	St. Clair	3.9	34.2	56.0	5.9	1.0	13,580	.....	49
Montevallo	Ala.	Shelby	2.9	38.4	52.8	5.9	0.8	13,700	.....	50–53
Blue Creek	Ala.	Tuscaloosa	4.7	24.4	61.7	9.2	0.6	13,360	.....	
Mary Lee	Ala.	Walker	3.6	30.9	53.0	12.5	0.8	12,320	2600–2900	51–65
Corona	Ala.	Walker	2.6	38.1	49.4	9.9	2.3	12,950	.....	51
Etna	Ga.	Dade	3.5	27.2	64.0	5.3	1.0	14,250	.....	
Durham No. 5	Ga.	Walker	3.1	20.0	70.5	6.4	1.0	14,190	.....	
Durham No. 4	Ga.	Walker	3.2	19.5	67.6	9.7	0.8	13,610	.....	
Sewanee	Tenn.	Grundy	3.3	29.7	58.0	9.0	0.6	13,260	2300–2700	50–61
U Clifty	Tenn.	Hamilton	2.8	29.7	57.6	9.9	2.5	13,430	.....	

Average or specimen analyses can only be broadly representative and hence must be used with caution. Analyses above, with exception of those for District No. 9, and all grindability figures, are condensed from a comprehensive Bureau of Mines survey covering each bed or seam in each county, state and district. It must be remembered that preparation changes coal characteristics. Bureau of Mines figures are from run-of-mine samples. Screenings would probably show slightly more ash. Prepared coals would show slightly less ash and sulphur, higher heating value and probably higher fusion temperatures. Grindability data (Hardgrove) are from Babcock & Wilcox Co. Bulletin No. 3-241. Being based on different samples, they do not relate directly to the analyses, but serve to give a general picture.

ity or power requirements. The latter are affected by size and type of pulverizer, and by feed size, moisture and fineness. The operator should check behavior of coals in his pulverizer against standard indices to establish a relation between pulverizer performance and grindability.

Caking, Coking. Considerable confusion exists regarding proper use of these two terms. Heating coal drives off volatile matter, leaving behind practically pure carbon. This is *coke*. It may take the form of small powdery particles or may fuse into lumps of varying size and strength. Swelling may occur. In commercial coke-making, "coke" generally refers to lumps of marketable size; *coking* coals make them.

Coke formation, in one shape or another, represents an intermediate combustion stage in any fuel bed; the difference lies in whether a plastic stage occurs and lumps of coke form. Coals that become plastic and form lumps or masses of coke are called *caking* coals while those that show little or no fusing action are *free-burning*.

Caking properties of a coal and the nature of the coke masses formed (size, strength, etc.) are valuable indicators of behavior in fuel beds. A recently adopted test measures *free-swelling index* and a proposed test determines *agglutinating value*, an approximate measure of that material in coal that fuses and becomes plastic.

SIZING OF COAL

Size Stability. Ability of coal to resist breakage is *size stability;* its opposite is *friability*, the tendency to break or crumble into smaller pieces. Where plant conditions make size an important factor, friability must be considered to get a rough idea of the difference likely to exist between size as shipped and as fired. ASTM has two tentative tests for these complementary properties: (1) *drop-shatter* test indicates resistance to breakage from ordinary handling (2) *tumbler* test, the effect of rougher handling in mechanical conveyors, feeders, etc.

Anthracite Sizes. Standard sizes are: *broken*, passing a 4⅜-in. screen, retained on 3¼-in.; *egg*, 3¼ to 2 7/16; *stove*, 2 7/16 to 1⅝; *chestnut*, 1⅝ to 13/16; *pea*, 13/16 to 9/16; *No. 1 buckwheat*, 9/16 to 5/16; *No. 2 buckwheat rice*, 5/16 to 3/16; *No. 3 buckwheat (barley)*, 3/16 to 3/32. *Culm* or *river coal* is refuse from screening anthracite into prepared sizes. It is now often dredged from rivers into which it was originally dumped.

Bituminous Sizes. There is little standardization of either screen openings or names given to sizes. *Run of mine* is unscreened coal as it comes from the mine; a steadily decreasing amount is shipped today because of demand for prepared sizes for domestic stokers, etc. Screen openings usually designate sizes. A "2-in. nut-and-slack" normally means all coal passing a 2-in. screen; amount of different sizes present may vary widely. Occasionally a limitation is placed on percentage of fines. So-called *between-screen* sizes (everything passing one screen and retained on another) give a closer idea unless spread between screens is large.

Coal size affects fuel-bed nature, draft required, density of coke formed, amount of unburned-carbon loss.

PREPARATION, STORAGE

Coal Preparation. Many producers now offer cleaned or washed coals as products having a higher value to users. Cleaning or washing removes impurities and so lowers ash content; it also tends to reduce sulphur in the form of pyrites and raise ash fusion.

Treating coal with refined petroleum oils of 100-600 ssu, or blends of petroleum products, allays dust nuisance in handling by eliminating most of the fine dust and much of the coarse. Treatment remains effective more than a year, even in outdoor storage. Experience seems to show that oil treatment reduces both moisture absorption of coal and freezing troubles. Tests show it does not increase spontaneous heating, nor appreciably affect burning.

Storing. Coal exposed to atmosphere combines with oxygen, liberating heat. Such slow oxidation is called *weathering*. It dulls the appearance of coal, causes reduction in size, impairs firing and coking qualities, and lowers heating value. These changes are practically unnoticeable for anthracite, and slight for most bituminous coals. Low-rank bituminous coals and lignite suffer more markedly. Loss of heating value over a 5-year period might run 1-3% for West Virginia and Pennsylvania coals, 4-6% for Illinois.

If heat liberated by oxidation is confined to a small area, temperature rises, increasing reaction rate. This cycle of rising temperature and faster oxidation continues until "hot spots" form and *spontaneous* combustion occurs.

To guard against such troubles: (1) Remember that small sizes pack tighter and present more surface, making them likelier to heat. (2) Avoid piling coal in hot weather or in a heated space. (3) Don't crush before piling, and watch pile closely during first three months since fresh surfaces oxidize more readily. (4) Avoid segregation of sizes by building the pile up in layers, leveling off and compacting each. (5) Check pile regularly, especially 5 to 8 ft below the surface of the flanks—temperature over 140-150 F means danger point is reached at which coal must be withdrawn. For storage details, see POWER, Sept. 1942, p 643.

Sampling. Coal composition varies within a given seam or mine and even between points several feet apart on the face. Although shipped from one point, coal composition varies from car to car and from one part of a car to another. Understanding the nature of all these variations makes it possible to use laboratory tests intelligently.

To begin with, a laboratory analysis, according to approved standards, represents within an extremely small margin of error characteristics of the sample on which it is made. How well the analysis represents the lot of coal involved depends on sampling methods. Until recently, size of gross sample was thought to be of major importance for accurate sampling.

Recent research shows accuracy of sample depends on number and size of increments composing it rather than on its weight. Proof of this point makes possible use of much smaller samples and simplifies reduction of gross sample to laboratory dimensions.

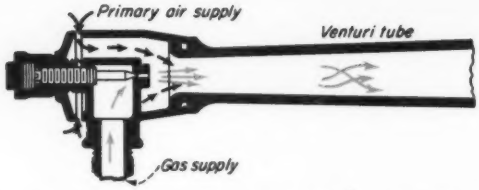
SAMPLING PROCEDURE

New ASTM standard distinguishes between "commercial" and "special-purpose" sampling and bases sample size and number of increments on coal size and expected ash content. Note that *increment* refers to quantity of coal obtained by a single sweep of the sampling instrument; where possible coal should be sampled while in motion.

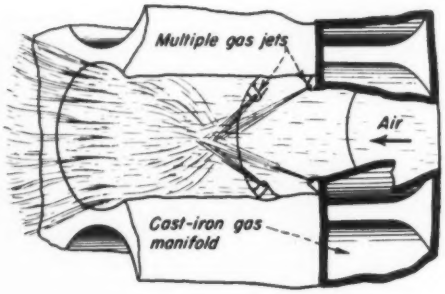
The standard provides for mechanical sample preparation and subdivision by large and small *riffle samplers* like those used in the laboratory. Commercial procedure is designed so 95% of test results fall within plus or minus 10% of ash content of coal sampled. Correct determination of ash value indicates accuracy of other results.

Knowing how closely a given analysis represents a given sample and lot of coal, we need also to know how reliable one test may be in predicting the average for a series of shipments, or, if average quality is known, what variation might be expected in individual shipments. Recent research shows that for bituminous coals of less than 9% ash, one-half of ash determinations depart from the average by no more than 0.5%; for coals of more than 10% ash, deviation is about twice as much.

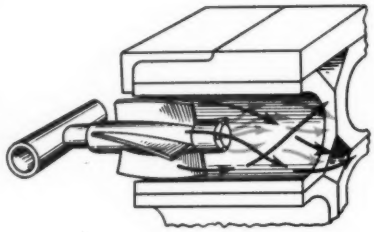
Common sense indicates that one test from one sample from one shipment is a poor guide. Statistical studies show that an average of ten shipments is three times as accurate as a single test while an average of 20 tests is 4.5 times as accurate. Beyond 20 tests, gain in accuracy is small.



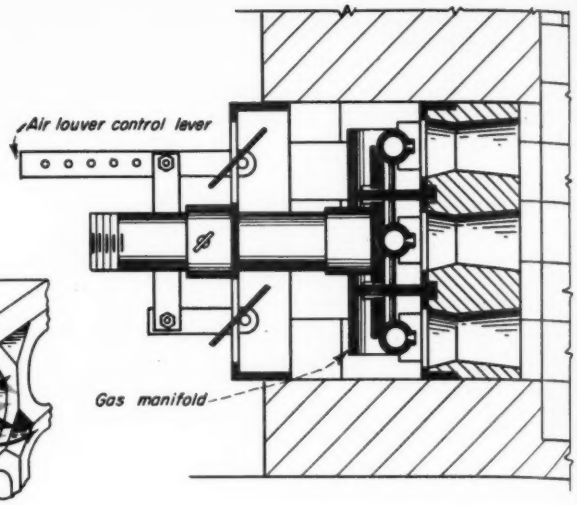
1 Atmospheric gas burners pull in their primary air for combustion by the action of a stream of low-pressure gas expanding through an orifice



2 Premixing of fuel gas and air needed for combustion takes place in a mixing chamber outside the furnace proper



3 Vanes placed in the path of incoming air to this tunnel burner act to impart swirling motion to stream



4 Gas issues from a number of spuds connecting to vertical and horizontal manifolds. Primary air enters around the spuds

Burning Gas

Knowing something about the general process of combustion and the various fuels met in power-plant practice, we're now ready to tackle the next element—firing equipment. Its job is to prepare the fuel, bring fuel and air together in proper proportions and, with the help of the furnace, ignite and burn the fuel-air mixture continuously.

GAS On the face of it, burning gas is simple, because the fuel is ready for combustion and requires no preparation in the strict sense of the word. Nevertheless, the remaining parts of the job—proportioning, mixing and burning—can be handled in a variety of ways and their characteristics need to be known for sound selection of equipment and successful operation.

Atmospheric Burners. Gas burners differ mainly in the way air and fuel mix. Perhaps most familiar is the so-called *atmospheric* burner. One form appears quite generally in the ordinary household gas range. In it the momentum of the incoming low-pressure gas stream is used to draw in, or *aspirate,* part of the air needed for combustion. A shutter or similar device regulates amount of air so induced. Gas and air together pass through a tube leading to the burner ports, mixing in the process. The mixture burns at the ports or openings in the burner head (with a blue, nonluminous flame. Secondary air is drawn into the flame from the surrounding atmosphere. Larger counterparts of this general burner type, having ring or sectional burner heads with many ports, are used to fire small boilers and industrial equipment.

A single-port atmospheric burner is shown in Fig. 1. Needle valve controls gas flow through the spud; air is drawn in around the shutter at the end. The resulting mixture passes through the tube and burns at its end. Single-port burners may be grouped, several banks high and wide, to serve larger furnaces.

Although physically simple, such a burner must be proportioned with considerable skill to conserve the relatively small amount of energy in the low-pressure gas stream. It is this energy which entrains the primary air. How well this is done depends on primary-air percentage, gas-orifice size, ratio of mixer throat to burner port area and, in boilers especially, furnace draft.

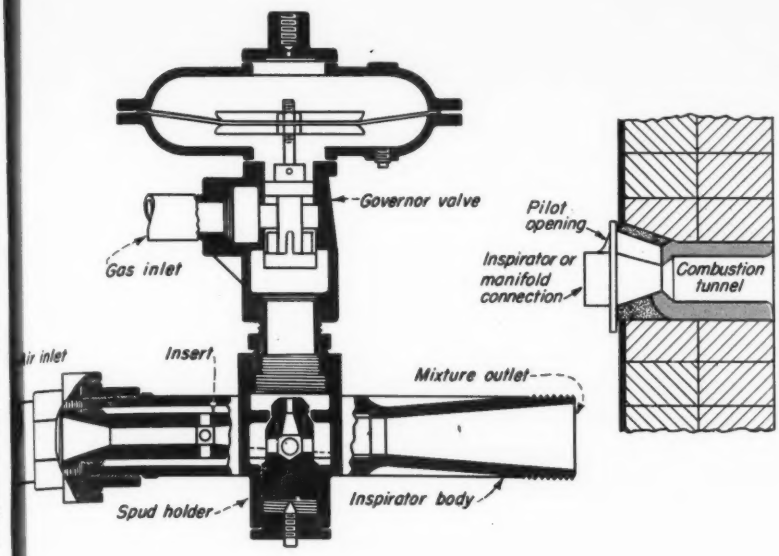
Premix Percentage. With burner-port size and shape fixed, nature of burning depends largely on amount of primary air, or *premix*. With premix low, flame is long and pale blue. It may have a yellow tip, indicating, as we have seen, some cracking and presence of free carbon. Increasing primary air shortens the flame as burning becomes more rapid, and a greenish inner cone appears. When speed of burning, or *flame propagation,* exceeds that of gas issuing from the port, flame flashes back into mixing tube.

Operation is generally satisfactory with 30 to 70% premix; in some special designs 100% primary air is used. This premix range gives a turn down, or capacity range, of about 4 to 1. Usually premix and capacity ranges are somewhat narrower.

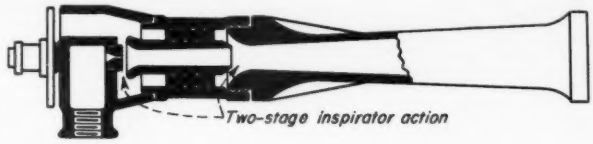
Secondary air is usually drawn in around the burner and the amount thus depends on the area of the opening and the draft. Control may be effected by varying draft or, sometimes, by adjusting opening area by shutters.

The so-called atmospheric burner is one example of a general class, in which the energy of one fluid is used to aspirate the other and in which part or all primary air mixes with the fuel in the burner body. The "high-pressure" burner uses gas at about 20 to 30 psig and air at atmospheric pressure. Another type uses compressed air, and the gas is at atmospheric pressure. The burner of Fig. 6 expands high-pressure gas through two venturi-sections in series to obtain thorough mixing in a short distance.

Refractory Burners. For boiler firing, a somewhat different type of burner finds wide use. It depends on natural or fan draft to draw in all air required for combustion; hence draft conditions are most important. Design of Fig. 2

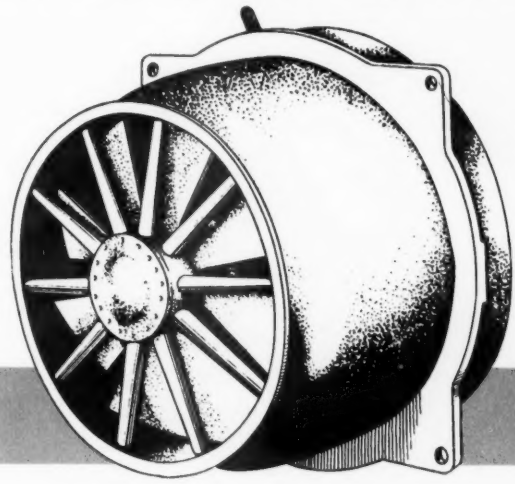


5 So called low-pressure gas-burner systems work with air under pressure and gas at atmospheric conditions. An inspirator governor, left above, delivers gas-air mixture at proper pressure to burner blocks, right above



6 Two-stage burner operates on high-pressure gas; passes it through two venturi sections in series. Primary air enters shutter, at left, under induction

7 High-pressure gas issues from jets in the spider and reaction spins the spider to rotate the fan. Resulting turbulence gives prompt, thorough mixing



s and Oil

employs multiple gas jets, which discharge into the air stream in such a way that violent agitation results in a short mixing tube or tunnel of refractory. In the burner of Fig. 3, turbulence vanes impart a swirling motion to the air entering the tunnel. Each of the small jets of gas issuing from the multiple-jet orifice entrains with the air and impinges it outward against the tunnel walls. This action gives turbulent, thorough mixing.

In the burner shown completely assembled, Fig. 4, vertical manifolds connect horizontal tubes, which contain individual gas orifices for the 15 tunnel blocks forming the complete burner (3 high, 5 wide). Louvers in front of the burner assembly control air admission. Each orifice discharges into a refractory mixing tube or tunnel.

In burners of this type the refractory tunnel aids in heating the mixture for ignition and protects metal burner parts from high temperature. The flame can be made relatively luminous, for high radiant-heat transfer.

Large steam-generating units often employ a high-pressure (2 to 25 psi) gas burner of the gas-ring, Fig. 20, center-diffusion tube, or turbulent, Fig. 7, design. The gas-ring, Fig. 20, has an annular manifold located between air register and furnace wall surrounding burner opening. Orifices drilled in this ring spray gas angularly across an incoming air stream controlled in quantity, velocity and rotation by the registers.

Fan-Mix Burner. In the burner of Fig. 7, gas issues from jets drilled at an angle in a rotating spider. Resulting reaction spins the spider and with it the connected fan. A shutter controls air drawn in, to maintain desired fuel-air ratio. Thorough mixing of gas and air result from the turbulent interaction of jets and air stream; combustion is completed close to the burner.

Thus far we have talked of designs in which fuel and air mix in or at the individual burner. Higher burner head pressure to overcome variable furnace draft, high overload capacity, uniform air-gas mix at all loads, and single-valve control may be had in a system in which mixture is made at one point and supplied to several burners. Such a system is shown in Fig. 5. This is the low-pressure type; gas is at atmospheric pressure while air is at 1 to 2 psi.

Inspirator Governor. Heart of the system is the inspirator governor, left, Fig. 5. Air passes through the venturi tube at high velocity to create a low-pressure region at the end of the straight run where gas ports are located. This pulls atmospheric-pressure gas through the ports into the throat and produces mixing. As the mixture expands through the inspirator body its velocity is converted to pressure.

Gas enters the governor under pressure and flows through the governor valve. A passage through the governor valve keeps pressure at governor outlet and on the under side of the diaphragm the same. With atmospheric pressure on the other side of the diaphragm, governor delivers gas at atmospheric pressure.

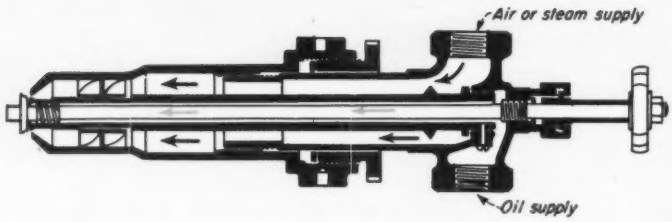
The mixture leaving the inspirator governor contains all air needed for combustion. An air valve controls the burning rate. The complete gas-air mixture goes from the inspirator-governor to a number of individual burners, usually the tunnel type shown at the right in Fig. 5. This principle of supplying a complete mixture to a number of burner units is also found in systems operating with high-pressure gas and atmospheric air.

OIL

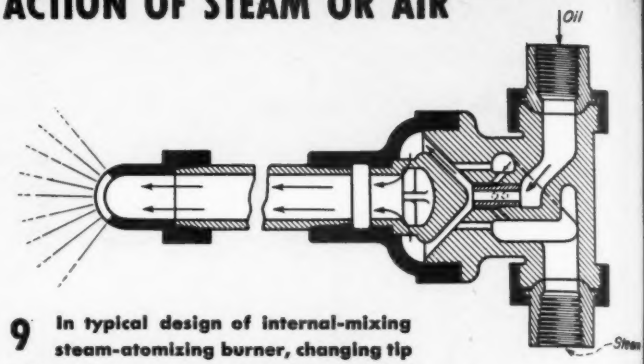
In addition to proportioning fuel and air, and mixing them, oil burners must *prepare* the fuel for combustion. There are two ways of doing this, with many variations of each: (1) The oil may be vaporized or gasified by heating within the burner, or (2) it may be *atomized* by the burner so vaporization can occur in the combustion space.

Designs of the first group, usually called *vaporizing burners*, are necessarily limited in range of fuels they can handle and find little power use.

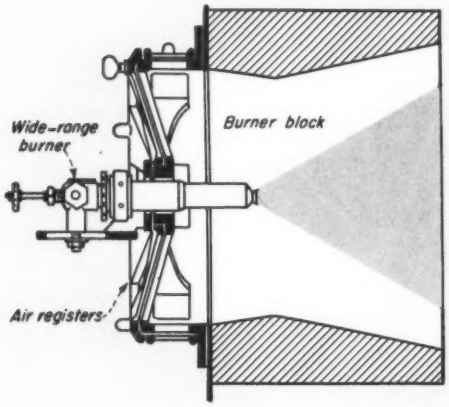
THESE BURNERS ATOMIZE FUEL OIL BY ACTION OF STEAM OR AIR

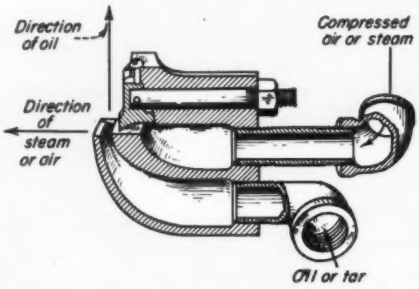


8 Steam-atomizing burner of external-mixing type, above, brings oil and atomizing medium, steam, together at the burner tip. Register, below, has damper vanes to regulate the air supplied

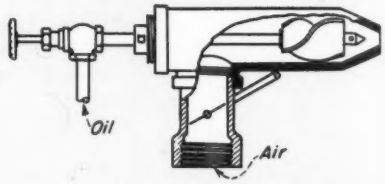


9 In typical design of internal-mixing steam-atomizing burner, changing tip alters the range of capacities handled





10 In this external-mix oil burner a steam jet hits the emerging oil at right angles as the oil leaves the burner; gives turbulent mixing action



11 Low-pressure air serves as atomizing medium for this burner, meeting oil at the tip and breaking it up. Air atomization finds relatively little use because cost is often high

If oil is to be vaporized in the combustion space in the instant of time available, it must be broken up into many small particles to expose as much surface as possible to the heat. This atomization may be effected in three basic ways by: (1) using steam or air under pressure to break the oil into droplets (2) forcing oil under pressure through a suitable nozzle, and (3) tearing an oil film into drops by centrifugal force. All three methods find use in practical burners.

Turbulence Necessary. In addition to breaking the oil into small particles for fast vaporization, the burner must provide motion between oil droplets and air, so vapor "coats" are stripped off as fast as they form and fresh surfaces exposed. This calls for penetration of the oil particles in the proper direction and for a high degree of turbulence in the air. Such relative motion of oil and air helps to produce more uniform mixture conditions over the combustion zone.

Hydrocarbons, as we have seen, burn by hydroxylation and by cracking. In practice, both forms are present, although the usual oil-burner flame is predominantly the latter type. This characteristic short yellow flame has good radiating characteristics and fits usual combustion spaces well. It carries, however, solid carbon particles, which, if their burning is stopped by any chilling action, form soot. Depending on the nature of the chilling, the soot may deposit on heating surfaces or may be carried out the stack as a major constituent of smoke.

Pure hydroxylative burning, while free from soot and smoke possibilities, yields a less radiative flame and can be produced only in certain types of burners. Thus, as in many engineering matters, we compromise and strive to introduce enough hydroxylation into a predominantly cracking process to keep the flame clean and reduce smoking tendencies. Hydroxylation is encouraged by thorough atomization, suitable preheating of both oil and air, and exposing the mixture to a gradually increasing temperature over not too short a time.

Steam-Atomizing Burners. Let's look now at practical oil-burning equipment. Oldest form is the steam- or air-atomizing burner. Installation is relatively inexpensive and simple, especially where no attempt is made to control steam and oil supply simultaneously. Steam-atomizing burners, as a class, possess ability to burn almost any fuel oil, of any viscosity, at almost any temperature. Air is less extensively used as an atomizing medium because its operating cost is apt to be high.

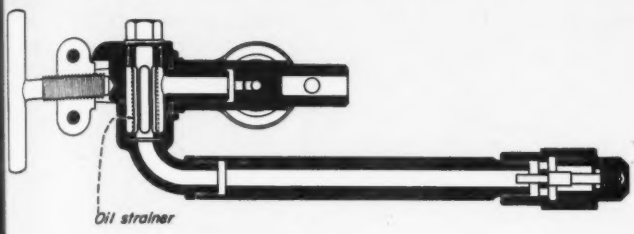
These burners can be divided into two types: (1) internal-mixing or premixing — oil and steam or air mix inside the body or tip of the burner before being sprayed into the furnace, Fig. 9, 11, and (2) external-mixing — oil emerging from the burner is caught by a jet of steam or air, Fig. 8, 10.

Steam consumption for atomizing runs from 1 to 5% of steam produced, usually averaging around 2%. Pressure required varies from about 75 to 150 psi, and steam can be taken from: (1) a low-pressure line (2) a desuperheater with a pressure reducer, or (3) a drum vent, through an orifice and regulating valve. Oil pressure need only be enough (usually 10 to 15 psi) to carry oil to the burner tip.

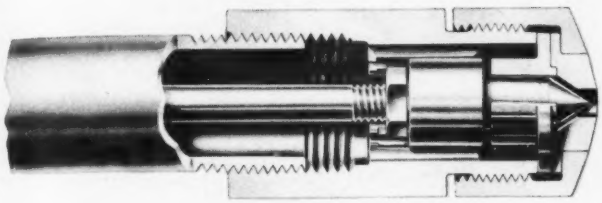
External Mixing. In the burner of Fig. 8, oil reaches the tip through a central passage, flow being regulated by the screw spindle, right. Oil whirls out against a sprayer plate to break up at right angles to the stream of steam, or air, coming out behind it. The atomizing stream surrounds the oil chamber and receives a whirling motion from vanes in its path. When air is used as the atomizing medium in this burner, it should be at 10 psi for lighter oils and 20 psi for heavier. Combustion air enters through a register, shown below in Fig. 8. Vanes or shutters are adjustable to give control of excess air.

Fig. 10 shows another external-mix-

THESE BURNERS ATOMIZE OIL UNDER PRESSURE BY MECHANICAL MEANS

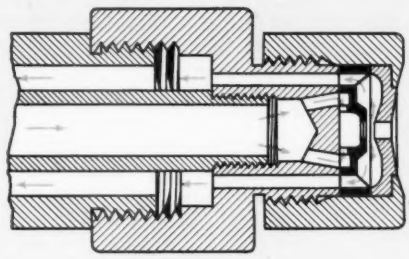


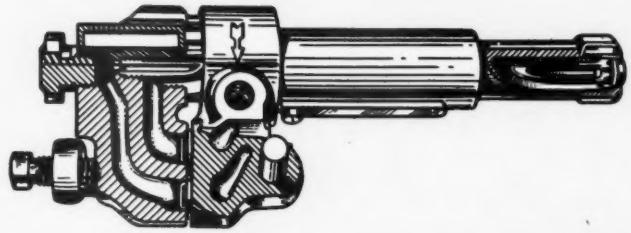
12 **Mechanical-atomizing burner receives the oil under pressure, about 225 to 300 psi, and at an optimum viscosity of about 150 ssu. Orifice atomizes the fuel**



13 **Movable control rod, center, through a regulating pin, varies the area of tangential slots in sprayer plate and volume of oil passing through orifice, right. With oil kept at 300 psi and 200 ssu, range is 10 to 1**

14 **With fixed orifice size, best atomization occurs in narrow flow range. Design at right obtains wide capacity range by supplying oil to burner tip at a constant rate in excess of demand. Oil burned varies with the load, rest is returned**





15 **Wide-range burner above operates on constant-differential systems shown, Fig. 16**

ing design. Oil and steam discharge through separate nozzles at right angles to each other, the steam breaking up the oil stream.

Internal Mixing. Fig. 9 and 11 give examples of the premixing principle. In Fig. 9, steam and oil meet and mix well within the burner body. Energy in the steam serves to force the steam-oil mixture through the nozzle for atomization. Burner of Fig. 11 brings oil and air under pressure together at the burner tip for mixing before discharge into the furnace.

Mechanical Atomizing. Now let's look at another major burner class, mechanical atomizers, Fig. 12 to 15. Good atomization results when oil under high pressure (75 to 200 psi or higher) is discharged through a small orifice, often aided by a slotted disk. The disk gives the oil a whirling motion before it passes on through a hole drilled in the nozzle, where atomization occurs. For a given nozzle opening, atomization depends on pressure and, since pressure and flow are related, best atomization occurs over a fairly narrow range of burner capacities (about 40%).

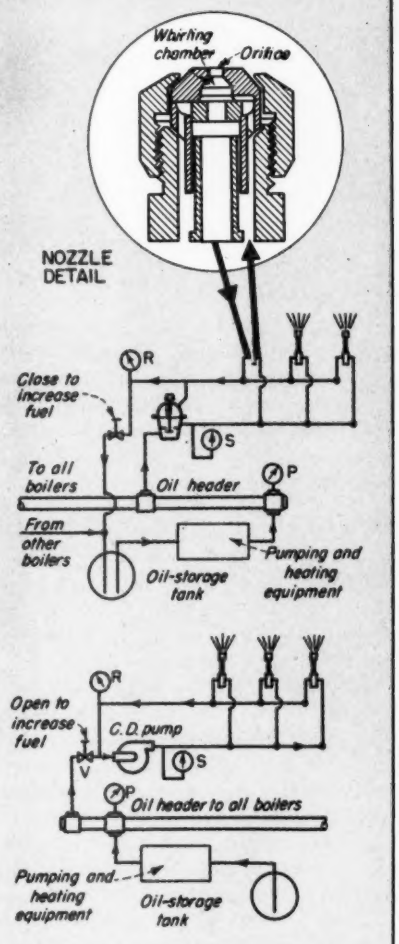
To follow a fluctuating boiler load, a number of burners may be installed and turned on or off as steam demand varies; or burner tips with different nozzle openings can be applied to a single burner body.

Wide-Range Designs. Oil-burner manufacturers have developed many designs to extend the usual 1.4 to 1 capacity range of the mechanical-atomizing nozzle. One, for example, features a plunger that opens additional tangential holes in the nozzle as oil pressure increases. This gives a 4 to 1 range. Another design, Fig. 13, employs a movable control rod, which, through a regulating pin, varies the area of tangential slots in the sprayer plate and the volume of oil passing the orifice.

Still another variable-capacity design, Fig. 14, delivers oil at high pressure (350 psi) at a constant rate, but discharges through the nozzle only the quantity needed to meet steam demand. The remainder recirculates.

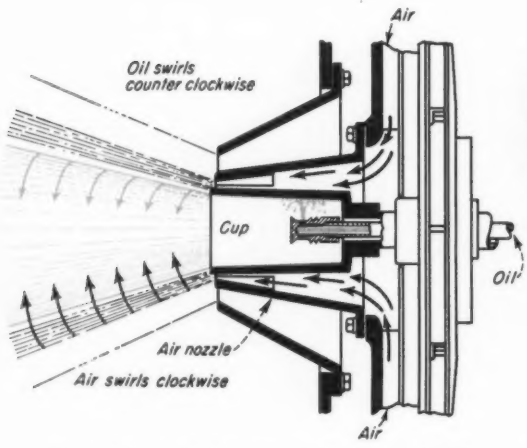
Fig. 15 shows a wide-range mechanical atomizer which, when combined with either of the pumping systems shown in Fig. 16, will give a capacity range of about 15 to 1, and considerably higher if needed. By use of either a constant-differential valve or pump, as shown, difference in pressure between supply and return is held constant. This maintains a uniform pressure drop across the tangential slots in the burner tip and creates a constant atomizing force. The valve system is simple to install and maintain, but the pump system offers advantages in many plants: (1) No hot oil is returned

HOW ONE WIDE-RANGE SYSTEM OPERATES

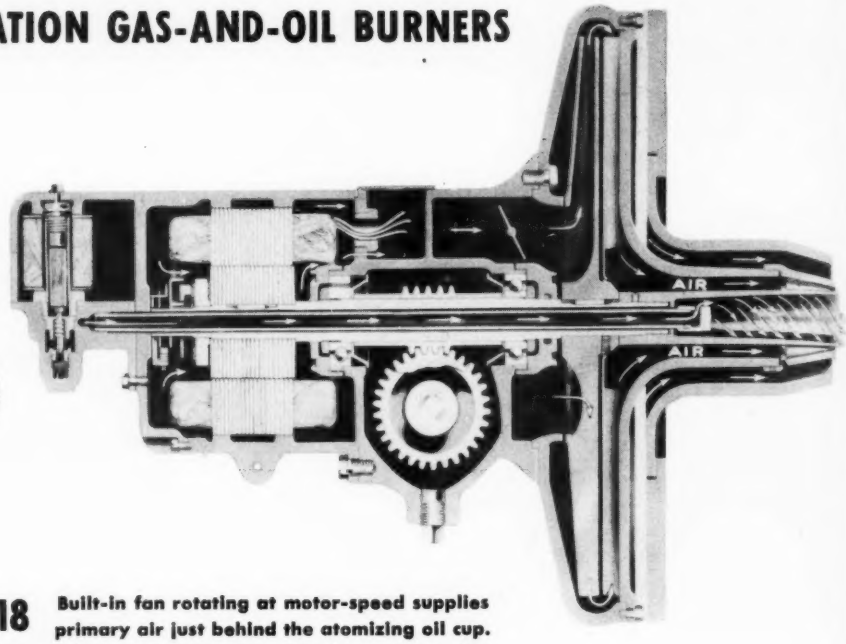


16 **Regulation of output from the wide-range burner of Fig. 15, whose atomizing and whirling end shows above, can come from either constant-differential valve or a constant-differential pump to hold pressure across supply and return**

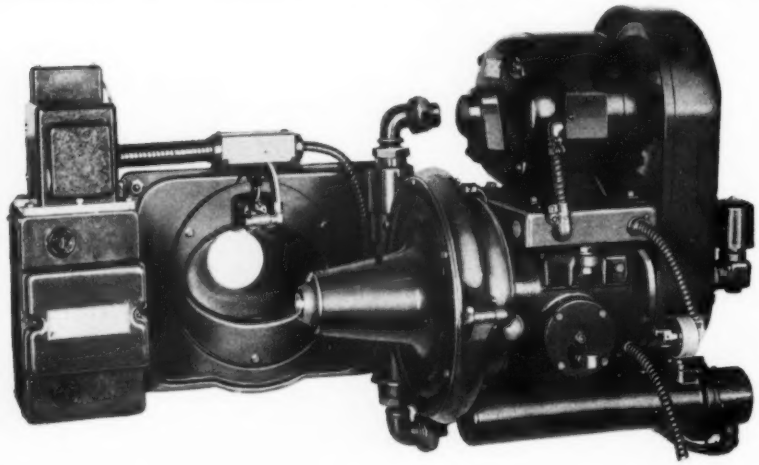
ROTARY-CUP AND COMBINATION GAS-AND-OIL BURNERS



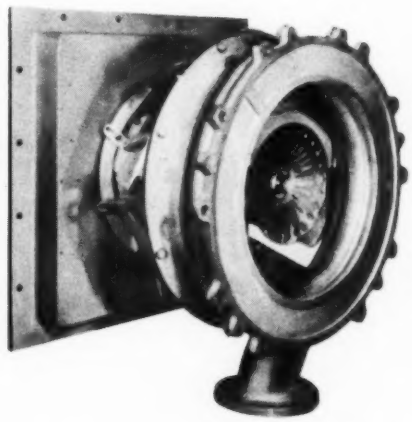
17 Cup revolving counterclockwise breaks up oil film at rim by centrifugal force and discharges into a clockwise air stream



18 Built-in fan rotating at motor-speed supplies primary air just behind the atomizing oil cup. Air catches up fine oil spray leaving at cup edge



19 Belt driven rotary-cup burner carries a fuel-oil reservoir to insure positive feed, and a submerged electric heater to hold oil at correct temperature. Gas pilot mounted overhead, together with low-voltage system, serves to ignite the oil



20 Combination gas and oil burner uses either fuel or both together; same register regulates primary air supplied

to storage tank or pump suction. (2) Fuel enters the closed circuit at the same rate it is burned, simplifying fuel metering and combustion control. (3) Pump may be used to boost pressure on existing oil-burner systems.

Rotary-Cup Burners. Third major class of oil burners, the horizontal rotary cup, atomizes fuel oil by literally tearing it into tiny droplets. A conical or cylindrical cup rotates at high speed (usually about 3500 rpm if motor-driven). Oil moving along this cup reaches the rim where centrifugal force flings it into an air stream, Fig. 17.

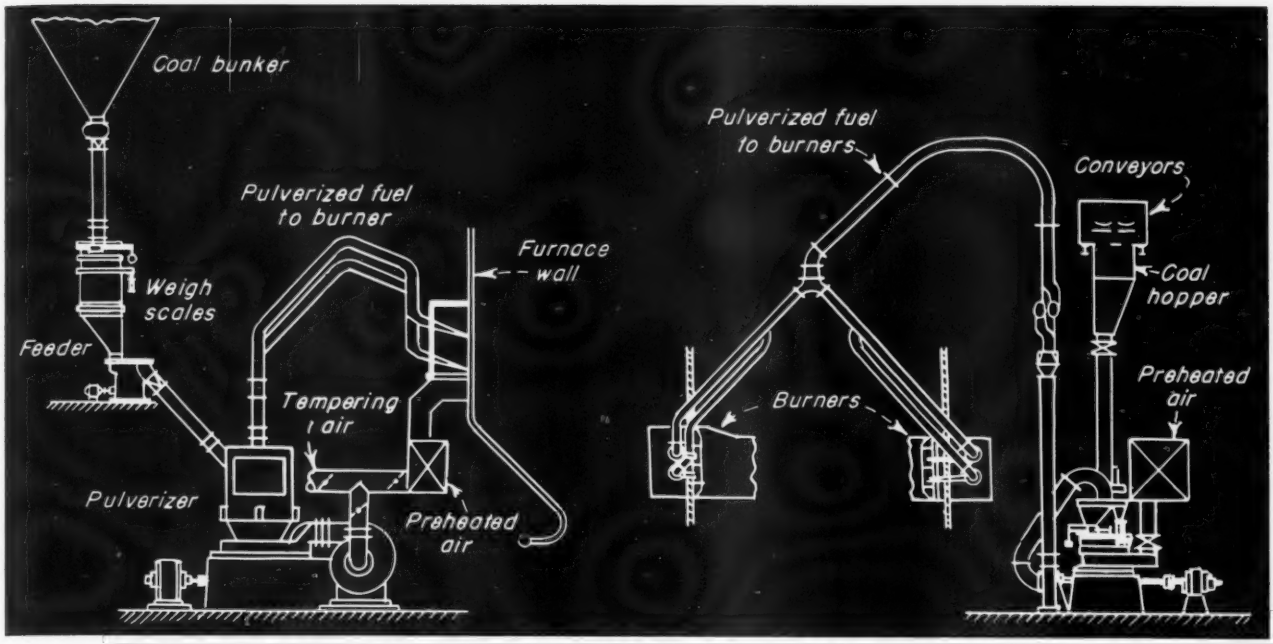
This system of atomizing requires no oil pressure beyond that needed to bring oil to the cup, and proves attractive in installations where only low-pressure steam is available. High oil preheat temperatures must be avoided since gasification may develop. The rotary cup can satisfactorily atomize oils of high viscosity (300 ssu), however, and has a wide range, about 16 to 1.

Fig. 18 shows a burner with a built-in driving motor, while Fig. 19 shows one with a belt drive. It also indicates provision for swinging the burner out of the furnace.

Gas and oil burners are often combined, as in Fig. 20. Designs of such combinations vary widely, both in nature of oil unit and gas unit. Their ability to handle either of the two fuels, or both at once, proves desirable in locations where both are available.

Burner Maintenance. Properly maintained, modern oil burners give highly satisfactory service. For peak performance, make sure that the burner gets uniformly free-flowing oil, clear of sediment that clogs burner nozzles. This means avoiding sludge buildup in storage tanks and keeping strainers in good condition. Preheat temperature must be right for fuel and burner type, and must be uniform.

Keep burners in good condition by watching for wear caused by abrasion of ash in fuel, and for carbon buildup. In rotary-cup burners, worn rims cause poor atomization. If cups are not properly protected after being turned off, carbon forms on the rim. When burner is shut down always take out the cup and insert a flame shield. Worn or carbonized mechanical-atomizing nozzles play hob; replace worn nozzles and keep them clean.



1 In this pulverized-coal firing system, pulverizer is held under positive pressure by forced-draft fan, must be tight

2 Exhauster fan puts negative pressure on mill but requires that special precautions be taken against severe fan wear

Burning Pulverized Coal

Ground to the fineness of flour, coal flows in pipes and handles in a furnace much as does oil. The job requires equipment for drying and pulverizing the coal, transporting it to the furnace in an air stream and injecting it along with the air needed for combustion.

Suspension Burning. Within a fraction of a second after one of these minute particles enters the furnace and is exposed to radiant heat, its temperature rises and the volatile matter distills off. Enough air (*primary air*) is introduced at the burner, intimately mixed with the stream of coal particles, to burn gas resulting from separate distillation of each particle in the stream. The volatiles, mostly hydrocarbons, ignite more easily than the carbon remaining in the particle and heat the latter to incandescence. *Secondary air,* introduced around the burner, sweeps past the hot carbon particles and gradually burns with them in a flame several feet long.

This job of grinding, transporting and injecting coal into the furnace may be handled in a number of ways. Originally the preparation phase was entirely separate. In the so-called *bin* system, coal was dried, pulverized, separated from the air used in the pulverizing mill, and stored to await demand. Being divorced from furnace operation, this system could operate at best capacity with constant fineness. Storage reduced need for spare pulverizer capacity. Burners could be controlled separately with ease.

Unit System. The *direct-firing,* or *unit,* system is now almost universally used in new plants. In it, pulverizers feed burners directly. There is no storage; pulverizer operation thus fluctuates with steam demand. This system is not only simpler, involving less equipment, but it avoids storage-bin fire hazard as quantity of pulverized coal never exceeds that in the mill and in the short lengths of piping to the burners. Elimination of a separate mill house, pulverized-coal storage, conveyors and feeders reduces capital outlay. Built into today's systems is the flexibility needed to handle various functions under a wide range of load and coal conditions.

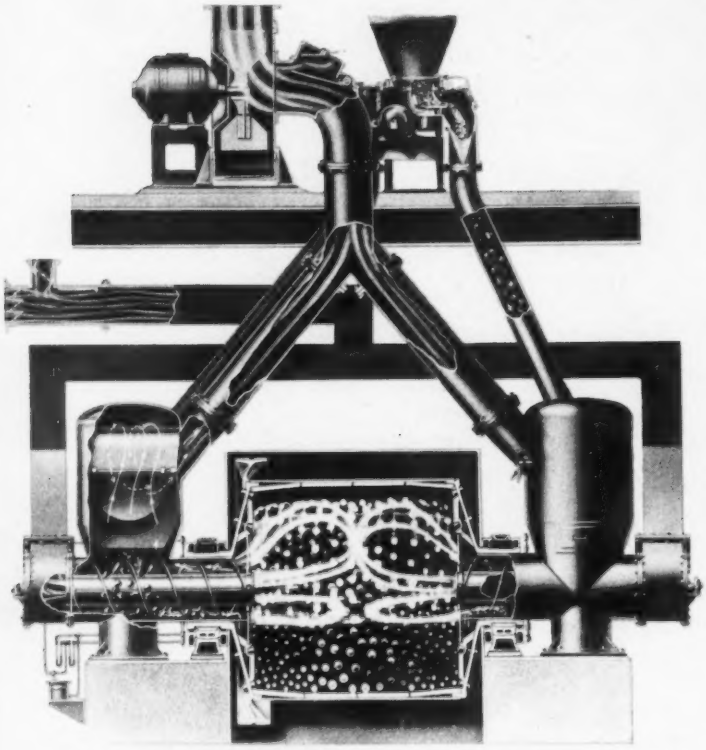
Heart of the unit system is the pulverizer, with its equipment for feeding raw coal at the proper rate, grinding the coal to desired fineness, classifying the finished product so oversized particles are returned to the mill, and delivering the coal in its transport air.

Basic Arrangements. In most mills, air performs three functions. It dries the coal, classifies the pulverized fuel leaving the grinding elements and transports the finished product to the burners. The mill and its associated fan can be arranged in either of two basic ways. In one, a forced-draft fan outside the mill supplies it with air under enough pressure to carry out the jobs to be done in the mill and to transport the coal to the furnace. The fan handles air only, which is an advantage, but the pulverizer must be kept tight.

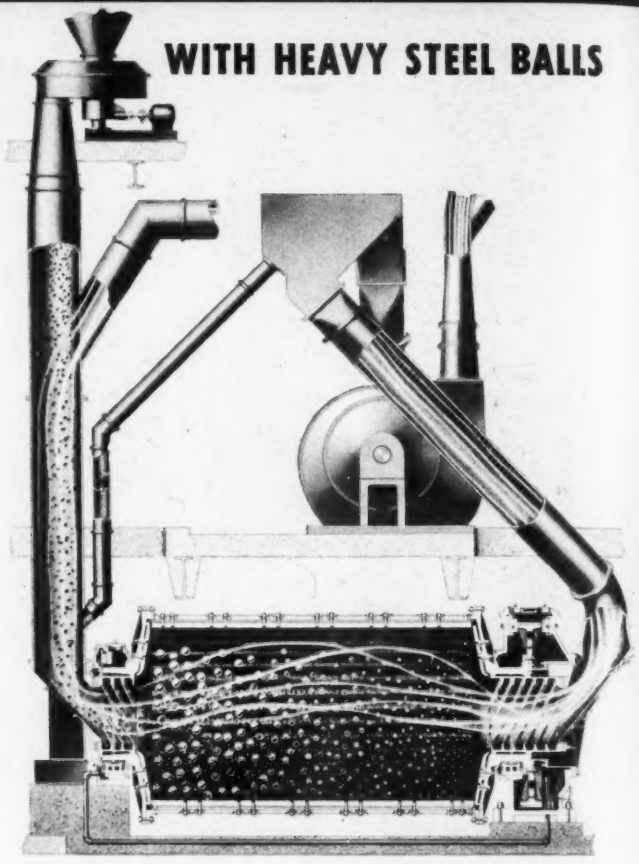
In the second scheme, the mill is under negative pressure developed by an *exhauster* fan, which may be combined with the pulverizer proper, or mounted externally. Since it handles air laden with coal, it must be designed to resist wear. Fig. 1 and 2 show typical layouts of each type.

Coal Preparation. Before taking a look at pulverizer construction, let's consider some factors that affect operation. First comes the matter of raw-coal size. Many plants receive, either regularly or occasionally, run-of-mine coal. While the usual feeder provides for rejecting oversized pieces, it is well to take as much load off the mill as possible. Thus some form of coal-crushing equipment represents a good investment. A further precaution for an

THESE PULVERIZERS TUMBLE COAL WITH HEAVY STEEL BALLS



3 Ball-mill pulverizer resembles a tumbling barrel with its rotating drum filled with coal and many heavy steel balls



4 Coal enters air-swept tube mill through feeder, upper left; leaves at right end of mill under pull of exhauster, above

uninterrupted and uniform supply of raw coal is a magnetic separator somewhere ahead of the pulverizer feeder. It removes tramp iron, which might block the feeder.

Usually a pulverizer does its job best when supplied with raw coal having definite size limits. These vary somewhat with mill size. In general, small mills do best on coals up to about ¾ in. top size. For medium and large mills, best top size goes up to about 1 in. and 1¼ in., respectively. For any specific mill the manufacturer's recommendations should govern.

Fineness. Quality of mill output, or *fineness,* is a highly important factor. It is normally expressed as the percentage of pulverized coal passing through a sieve with openings of a specific size. Commonest sizes for pulverized-coal testing are 50-mesh for determining oversize, and 200-mesh for powdered dust. Number of openings per lineal inch fixes the mesh of a screen. The 50-mesh sieve, for instance, has 50 openings to the inch, or 2500 to the square inch.

Fineness of pulverization obtained from a mill depends on a number of factors: Grindability, ash content and moisture of the coal may be some of these. The fineness desired likewise depends to a great extent on coal characteristics and the way they affect behavior in the furnace. For example, coking coals, when exposed to furnace temperature, swell and form lightweight, porous coke particles. These can easily float out of the furnace before they are burned. As a result, carbon loss can run high unless pulverization is very fine. Free-burning coals do not have the same swelling characteristic and hence do not require the same fineness.

Effect of Volatile. Again, high-volatile coals ignite more readily than low-volatile. And since ease of ignition dictates somewhat the degree to which fineness is carried, it follows that high-volatile coals as a class need less-fine pulverization than do low-volatile coals. On the other hand, low-volatile coals, with the single exception of anthracite, have higher grindabilities, because they are softer. The balance of these compensating factors determines results in any given case.

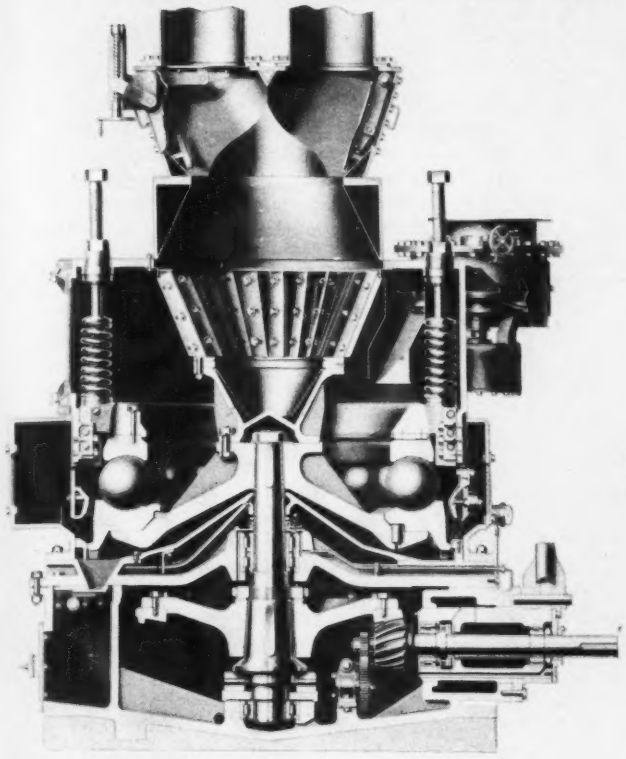
Before turning to any consideration of fineness specifications, it would pay to see more exactly what the term means. Coal from a pulverizer consists of a continuous band of particle sizes from coarsest to infinitely fine, distributed according to laws of probability. Plotting amount of each size yields a typical frequency curve, with a peak at some particular size. Shape of the curve and size occurring in greatest amount depends on the coal and the pulverizer.

In power plants, prime purpose of pulverizing is to eliminate oversize. No matter what the percentage of coal that will pass 200-mesh, as little as 5% over the 50-mesh limit may result in slagging and increased combustible loss. That is why most specifications call for at least 98% through 50-mesh.

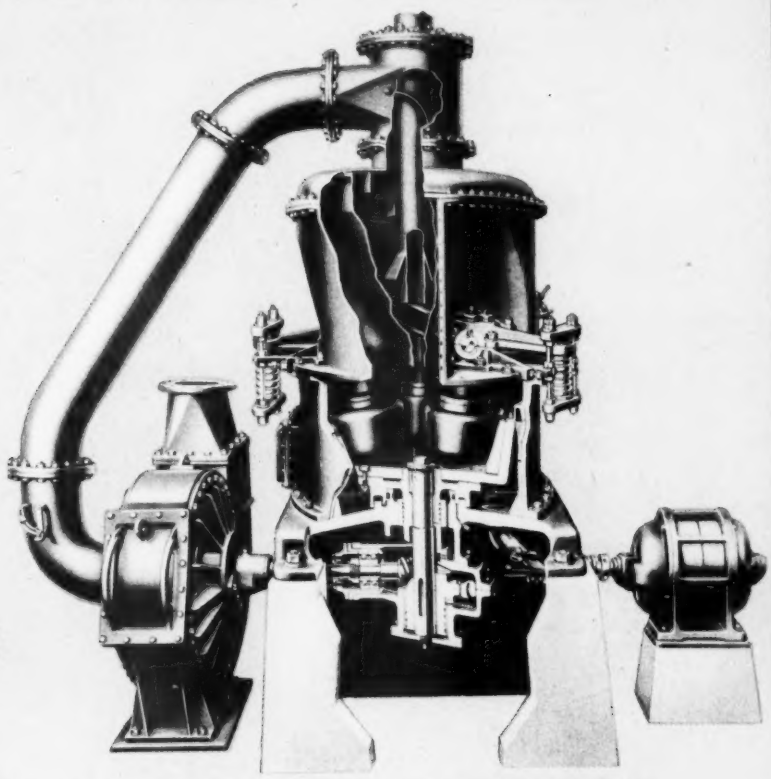
Economical fineness may be defined as the point where total cost per lb of steam, including fuel, operating and capital costs, becomes a minimum irrespective of boiler efficiency. This recognizes the fact that reduction of a small percentage of coarse particles, to obtain complete combustion in the furnace, may require an increase in operating and capital cost that is out of proportion to the value of the gain in efficiency.

Mill Capacity. What about factors affecting mill capacity? Just as with fineness there are several. Mill capacity does not vary in direct proportion to

COAL IS GROUND BETWEEN MOVING SURFACES IN THESE MILLS



5 **Pulverization takes place between balls and grinding rings. Adjustable springs maintain grinding pressure and fineness**



6 **Whirling bowl and rollers mounted on pivoted axles reduce to a powder coal thrown between them by centrifugal force**

grindability. Ash and moisture content of the coal, and fineness desired, may play important parts.

A basic premise in setting mill capacity is the assumption that enough heated air will be available to dry the coal. If this is not the case, it is the drying operation that limits mill output, not grinding. Thus it may be possible to obtain more capacity with a dry coal of lower grindability than with a wet high grindability coal.

Nevertheless, a knowledge of grindability properties is helpful information in rating a pulverizer. In recent years manufacturers have developed correction factors that take into account influence of coal properties.

Drying Coal. Let's look at one more problem common to all pulverizing before examining specific mills. That common problem is moisture and specifically *surface* moisture. *Inherent* moisture, that is, moisture actually held within the coal, does not greatly affect pulverization. Drying of coal undergoing pulverization, then, need only be enough to remove objectionable surface moisture.

The extent of drying that can be done within a given mill depends somewhat on its design. For example, most mills are arranged so incoming wet coal mixes immediately with the drier coal inside. Without this quick mixing mill feed end may plug with wet coal.

Primarily, though, the amount of heat that can be introduced measures the success or failure of the drying step. Where air flow acts as the drying medium (the most usual arrangement) the mill must be able to handle fairly large volumes of high-temperature air. Conditions within the mill should be held at a relative humidity below that of saturation at mill outlet temperature, roughly 150-160 F.

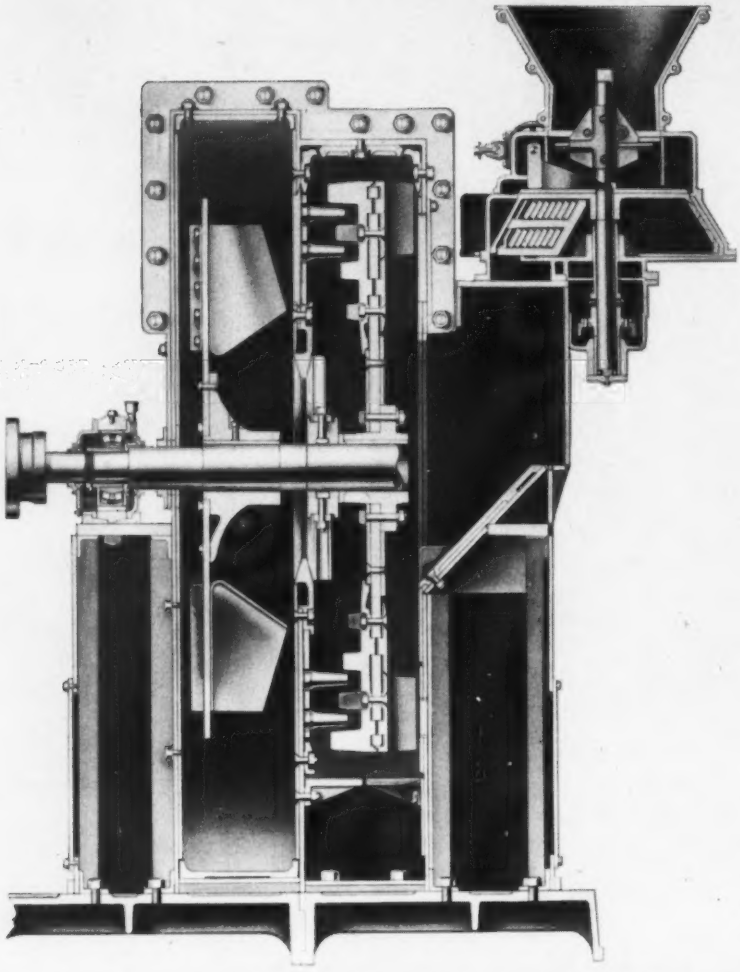
Air Supply. With today's steam-generating units, a supply of preheated air at about 500 F or higher, depending on coal moisture, can be obtained readily. The mill should be so constructed that it can handle air at this temperature without need for tempering to avoid preignition with dry coals.

We are now ready to look at typical current pulverizer designs. These employ three basic forces, singly or in combination: (1) impact (2) attrition, and (3) crushing. The nature of these forces becomes apparent when their application is seen.

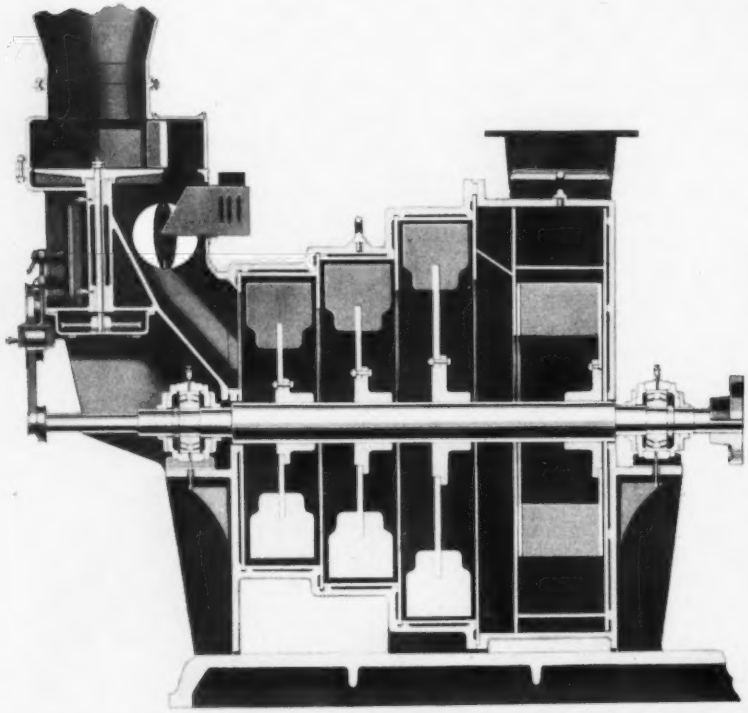
Ball Mills. The ball mills of Fig. 3 and 4 are essentially horizontal rotating cylinders somewhat longer than they are round. This physical shape leads some to describe them as tube mills. Usual design employs cast liners for the interior. Steel or special alloy balls, ranging from 1 to 2 in. in diameter, are dumped into the drum and fill it to just under half full. The mill rotates slowly, depending on tube diameter, but speed is of the order of 20 rpm. The balls carry part way around the cylinder circumference, then slide back toward the bottom. Coal, intermingled with the balls, undergoes impact from falling balls and attrition and crushing from the sliding mass.

Classifying Action. Hot air passes through the mill to dry coal, classify it after grinding, and transport finished product to burners. Operation of a typical classifying arrangement can be seen in Fig. 3. Passing through main vertical body of classifier, coal-air stream undergoes sharp change in direction, which throws out oversized particles. These *tailings* reenter the mill with incoming raw coal. Coal-air stream leaving classifier carries only coal that meets desired fineness limits. Opening the bypass damper in the scroll of the classifier increases coal output and reduces fineness.

IMPACT IS THE MAJOR FACTOR HERE



7 Pulverizer combines impact, attrition forces to powder coal in two steps. Hammers in first stage supply impact and pegs in second furnish attrition



8 Series of impact stages gives high degree of coal fineness at pulverizer outlet. Preheated air dries coal. Exhauster fan can be seen at right end

Returning oversized particles, which have already been dried, helps general operation by reducing average moisture content of coal entering the pulverizer and cuts down any tendency of incoming coal to plug at the inlet.

Crushing Action. Fig. 5 and 6 show pulverizers that grind coal between two surfaces moving in relation to each other, with crushing as the principal pulverizing force. One design, Fig. 5, employs as the moving elements balls that are held between two races. Grinding pressure is adjusted by controlled tension of springs shown in cutaway.

Coal in the raceway between and around the balls is subject to various pulverizing forces as the balls rotate. The entire mill operates under pressure. An outside fan blows a stream of preheated air through it to dry, classify and transport pulverized coal.

The mill of Fig. 6 has a grinding ring carried by a revolving bowl whose rim speed is about 1200 fpm. Stationary rolls, preloaded by springs, are set so they do not contact the ring. When incoming coal reaches the spinning bowl, centrifugal force throws it against the slant-faced grinding rim and into contact with the rolls. Ground coal is thrown from rim into annular passage surrounding it. Here partial classification takes place with heavy particles rejected back to the grinding ring by deflecting plates.

Remaining coal particles carry along on the exhauster-induced air stream into the classifier, where the stream undergoes a whirling motion to dislodge heavier particles. To a large extent, adjustable vanes on the classifier set the fineness of output.

Impact, Attrition. Fig. 7 illustrates a mill combining impact and attrition forces, working under suction. A series of hammers make up the primary pulverizing stage into which flows a stream of hot air pulled in by fan action of the hammers. Partly ground coal passes around the outside of the rotor into the final pulverizing stage, which consists of pegs on a rotating disk that travel between stationary pegs. Coal in the turbulent air stream rubs against pegs and other coal particles to be reduced by attrition. A fan pulls out the fines; rejector arms in the path of this coal-air stream return heavy particles.

Impact Pulverizer. The pulverizer of Fig. 8 consists of a series of impact stages with an exhauster fan at the mill outlet. As coal-air mix proceeds from stage to stage, individual particles become progressively finer. Preheated air enters at the left to perform its usual functions of drying and transporting.

A rather different treatment of the

basic pulverizing forces shows in Fig. 9. Here raw coal from a supply hopper is pushed by a feeder shoe into the grinding chamber below the rotating element. Incoming fuel particles do not come in contact with the rotor on entering the chamber. Instead, the coal adds to a dormant body of fuel lying on the pulverizer bottom.

Into this atmosphere, under pull of the rotor, in effect a closed-end fan, comes the preheated air stream. This stream whips across the dormant fuel bed and sets up a scouring, sandblasting action between coal particles pulled up in the stream as well as those on the surface of the fuel bed.

The pulverized product passes on with the air stream into the separator above. There the mixture goes through a spinner cone, where the coal-air stream experiences several sharp changes in direction to dislodge heavier particles from the stream. These fall back for further attrition.

Fluid Pulverization. The unit of Fig. 10, introduced recently, contains no moving parts; the expansive force of steam or air is employed to create strong attrition action.

Raw coal not exceeding ⅜ in., either wet or dry, enters the mill through a venturi. For wet coal, steam superheated to a total temperature of 750 F serves as the working medium, drying and pulverizing the coal simultaneously. As the coal enters the venturi it comes into the steam jet's path and is forced down into the pulverizer onto a protection cover. It falls through this cover to the pulverization zone in the bottom steam-jet block, where it is pulverized by steam issuing from several jets.

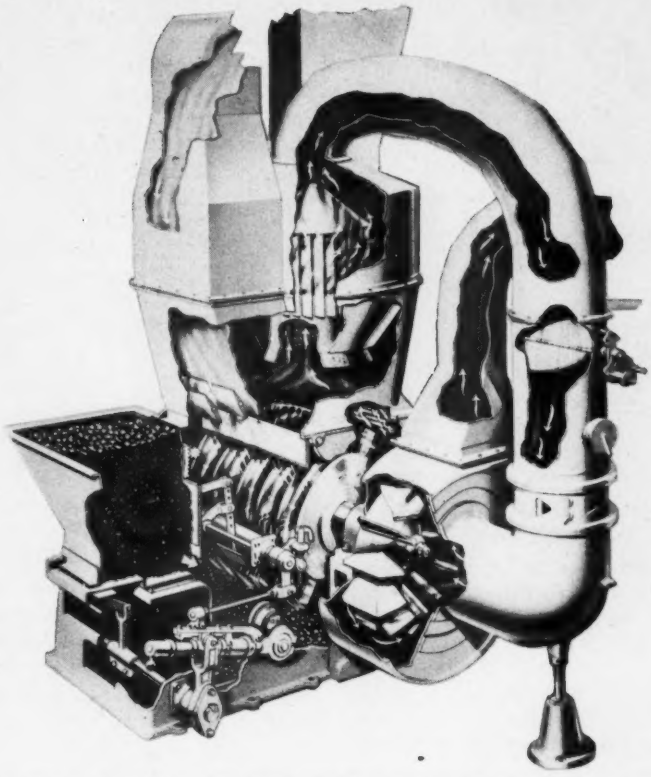
From this pulverization zone the fuel particles are carried with the steam through the uptake leg, back through the classifier where the heavier particles drop back for further pulverization. There is enough energy left in steam-coal mix for delivery to burners. No fan is needed for transport.

Fluid forces are also employed in the pulverizer of Fig. 11, which is designed for ultra-fine grinding. Raw material—minus 4-mesh or less—enters under inspirator action to be broken down still finer. Such fine pulverization goes beyond present power-field requirements, but for gas-turbine applications, and other uses such as grinding coal for colloidal fuel, it may well be the answer.

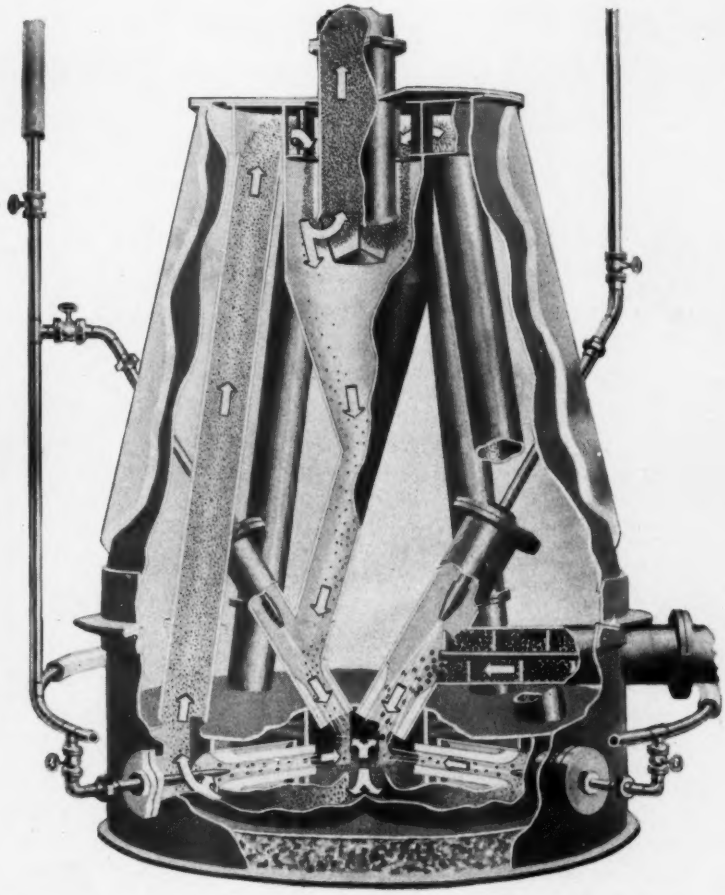
Disk Feeder. The job of delivering an uninterrupted flow of coal to the pulverizer, at the rate set by steam demand, falls to the feeder. Although details vary, feeders fall into two broad classes—disk or plate, and drum or roll.

Fig. 12 shows a totally enclosed disk feeder made in sizes for feeding from

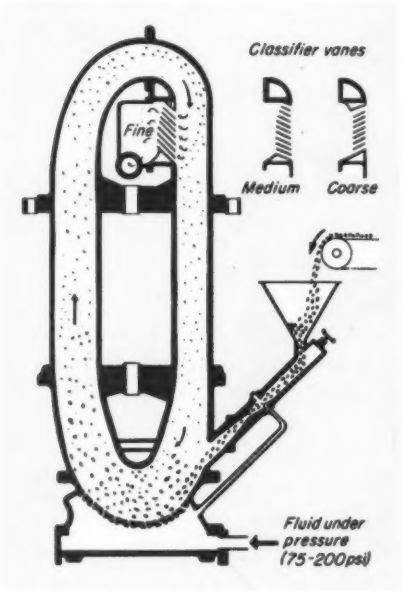
ATTRITION DOES THE WORK HERE



9 **Size reduction results from attrition produced when incoming coal, under pull of a high-speed rotor, sweeps across fuel on the pulverizer bottom**



10 **Four jets of steam (or compressed air) converge to set up a low-pressure area where coal enters. Attrition between particles does the pulverizing**



11 **Fluid expansion sets up attrition action for an ultra-fine pulverization**

a few pounds to 50 tons per hr. It consists of a rotating disk, usually direct-connected to a variable-speed motor. An adjustable sleeve in the downspout from the supply bin terminates a sufficient distance above the disk to form a cone over the center of the disk. An adjustable knife or plow cuts into the rim of the cone and plows or scrapes coal over the disk edge into feed chute. Feed rate can be varied by changing knife position or disk speed.

Drum Feeder. Illustrative of the second general class of feeder, the drum type, is Fig. 13. A slowly revolving 8-pocket drum feeds coal from the hopper. A spring-loaded leveling apron measures out equal quantities for each pocket. Rate of feed is controlled by a variable-speed transmission driving the feeder drum. A revolving wiper removes any coal that adheres to the bottoms of the pockets.

Burner Functions. So far we have concentrated on the preparation phase of pulverized-coal firing. Next we come to the burners themselves. These must supply air and fuel to the furnace in a manner that permits (1) stable ignition (2) effective control of flame shape and travel, and (3) thorough and complete mixing of fuel and air.

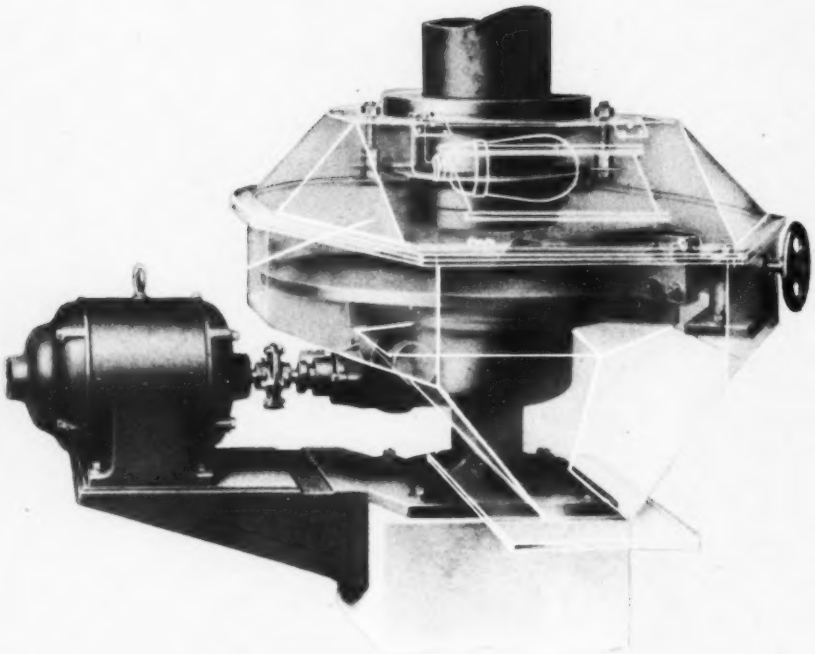
The air used to transport the coal to the burner forms the primary air; secondary air may be introduced in the burner (so called *turbulent* burners) or around or near the burner (so called *nozzle* burners). The turbulent burners of Fig. 14-17 impart a rotary motion to (1) the coal-air mixture in a central nozzle and (2) the secondary air issuing from a chamber around that nozzle —all within the burner. This gives some premixing for coal and air, and considerable turbulence.

In the burners of Fig. 18, 20, the coal-air mixture issues from a series of nozzles to mix within the furnace with secondary air admitted through separate openings.

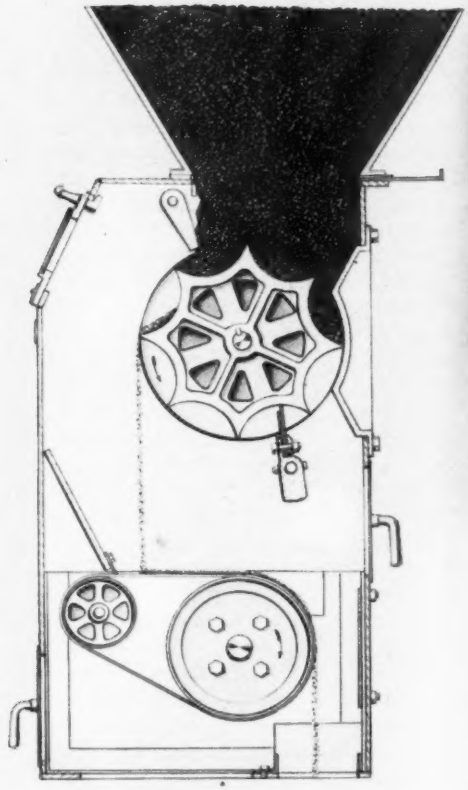
Burner Location. The great majority of burners fire into the furnace horizontally, usually from only one wall. In the customary arrangement, a burner block of refractory surrounds the burner opening. If the wall carrying the burners is watercooled the tubes bend around the burner opening. Fig. 18 shows a type of burner designed to fire between waterwall tubes with minimum disturbance of the spacing.

Vertical burners are also employed. Early designs had the primary-air and coal nozzle at the top of the furnace chamber pointing downward, more or less vertically. Secondary-air nozzles directed air into the furnace horizontally, for flame control and turbulence. A typical vertical burner of today, Fig. 20, leads secondary air around the burner nozzles in baffled streams.

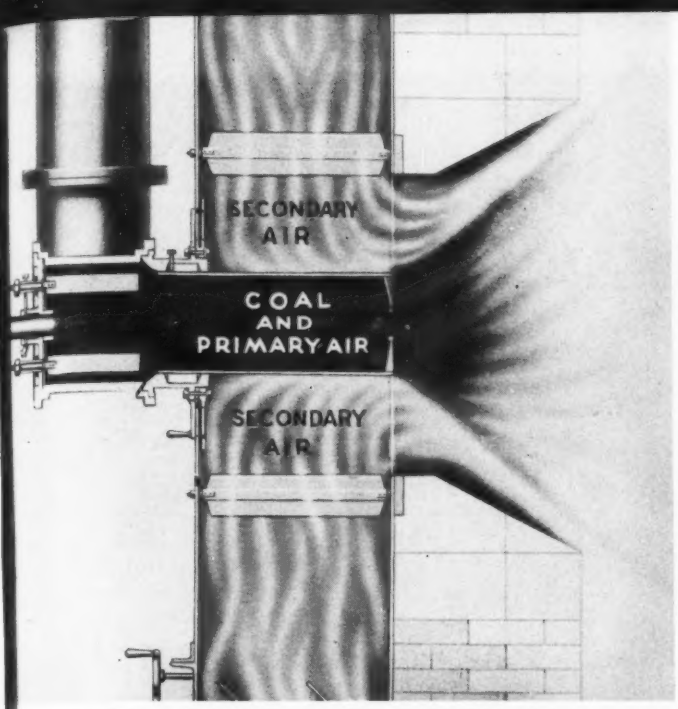
TYPICAL COAL FEEDERS FOR PULVERIZERS



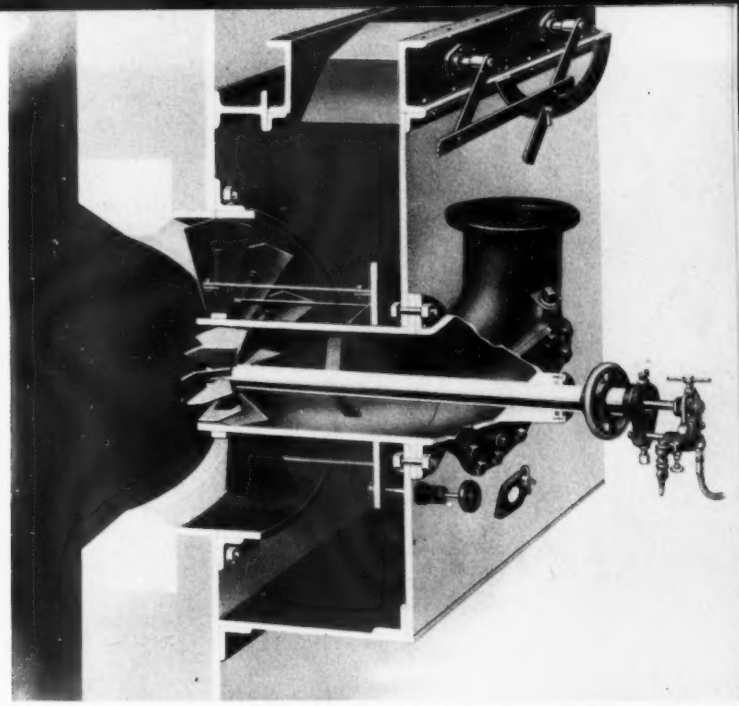
12 **Downspout piles up coal in a cone on disk feeder; adjustable blade scrapes coal from rim of cone into feed chute**



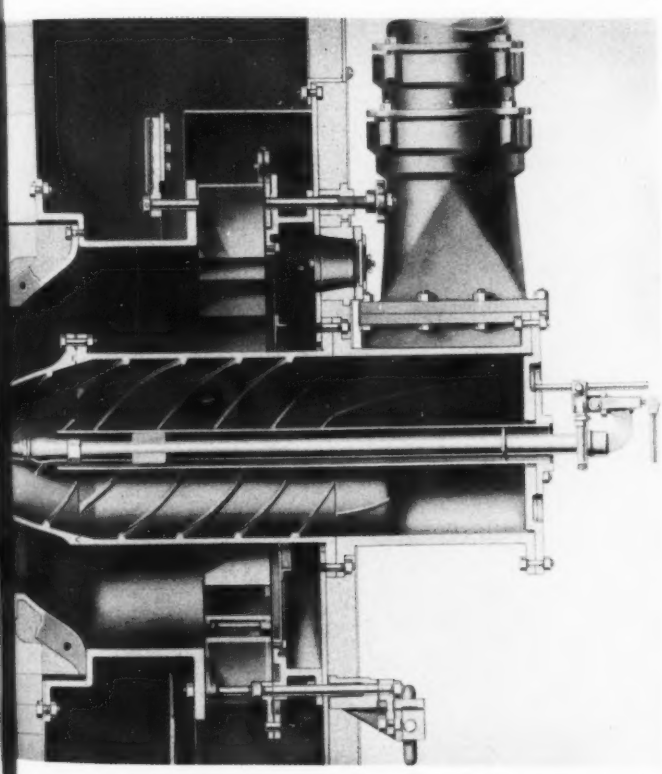
13 **Rotating drum operating at variable speed carries coal to magnetic separator; revolving wiper removes sticky coal**



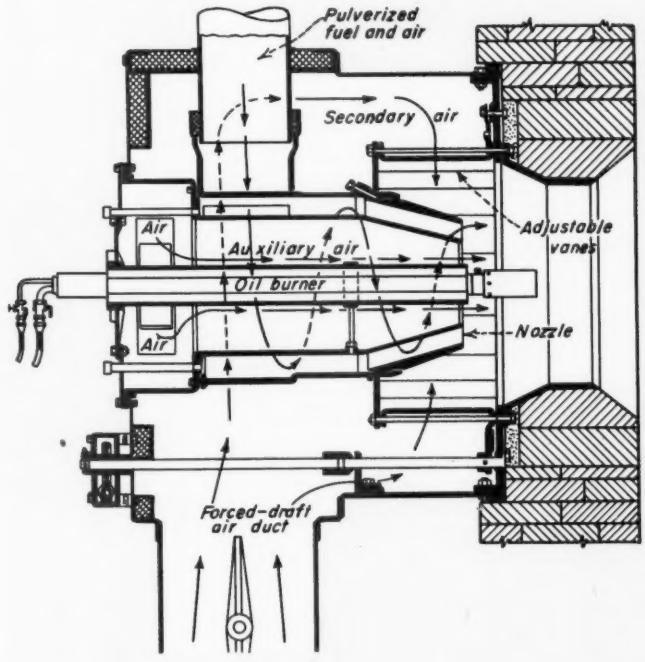
14 Rotary impeller mounted on ignition tube serves as a coal spreader to insure a good fuel-air mixture leaving burner



15 Horizontal flare burner employs coal spreader in path of primary air and coal; secondary air surrounds the outlet



16 Turbulent burner for coal and oil firing rotates incoming fuel-and-air mixture, center, also adds secondary air



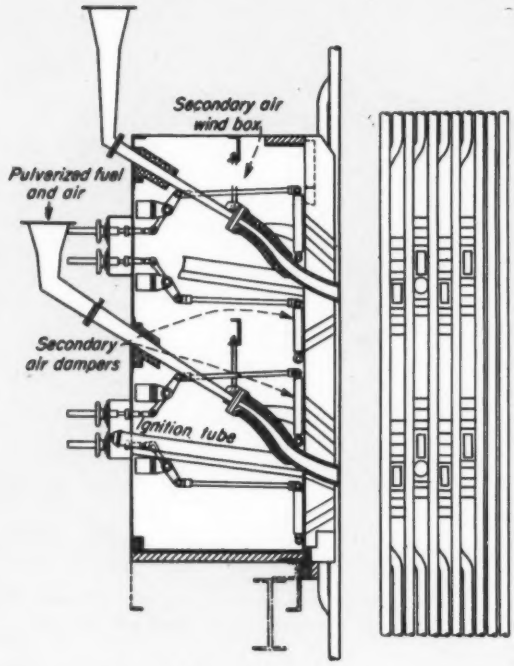
17 Intervane burner has primary air and coal whirling around a cylinder enclosing auxiliary air passage and oil burner

Horizontal burners may be located in such relation to each other as to promote turbulence. In *opposed* firing, burners in opposite walls of the furnace play their flames against each other.

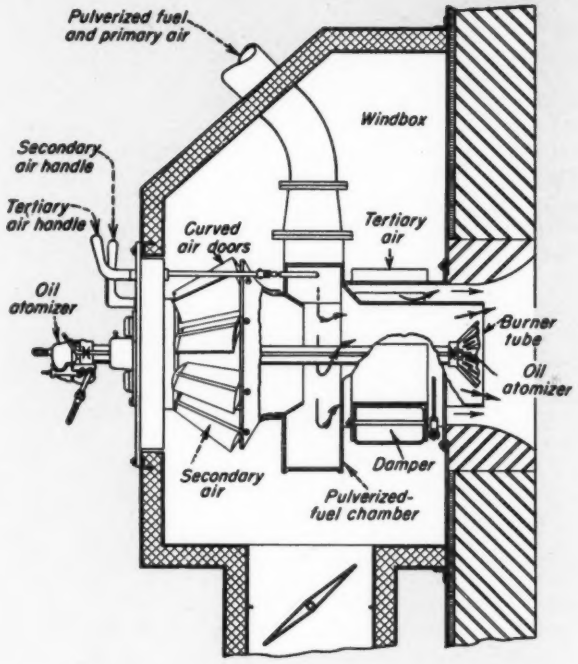
Tangential Firing. Here, burners in furnace corners direct their flames tangent to an imaginary circle in the furnace space. Pronounced turbulence can be set up in this fashion and there is a tendency for unburned combustible in the "tail" of one flame to be caught up in the second. A special form of tangential firing appears in Fig. 22; burners are adjustable to shift flame zone vertically and so regulate temperature of furnace exit gas according to load. This, in turn, controls superheat over a wide load range. Later installations of this type employ fully automatic control of burner inclination.

Combination Firing. Fuel problems of the past war emphasized the value of fuel flexibility and of burners capable

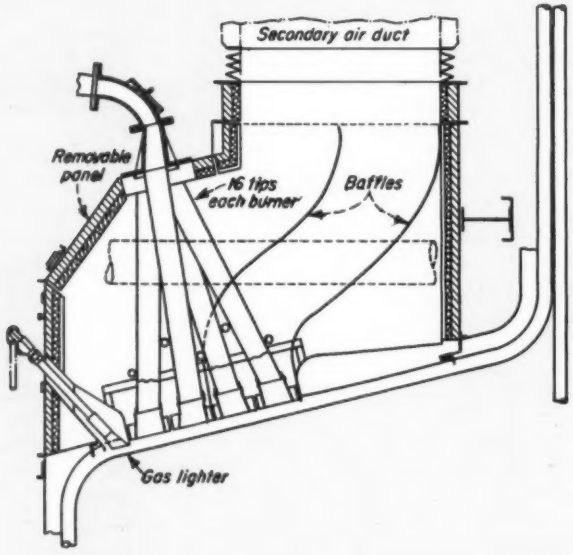
TYPICAL BURNERS, IGNITION DEVICES AND SPECIAL FURNACES



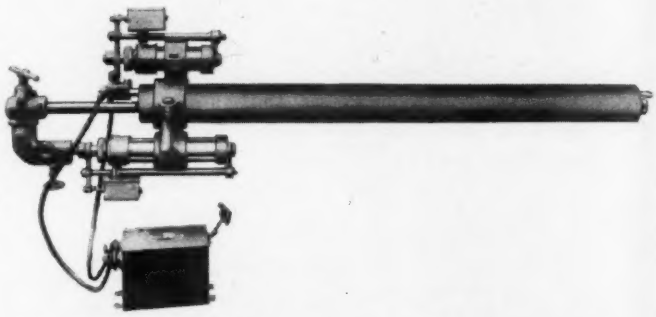
18 Intertube burner consists of a wide fantail distributor to spread coal in broad stream; nozzles form it into jets



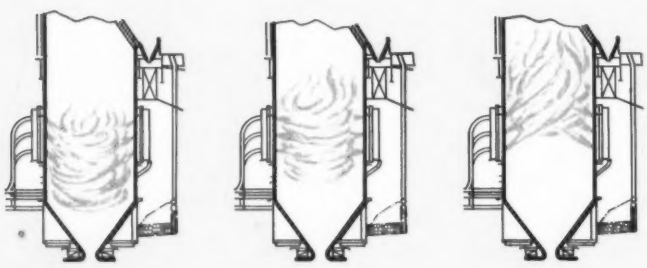
19 Combination coal and oil burner handles primary, secondary and tertiary air; gives fuel flexibility often needed



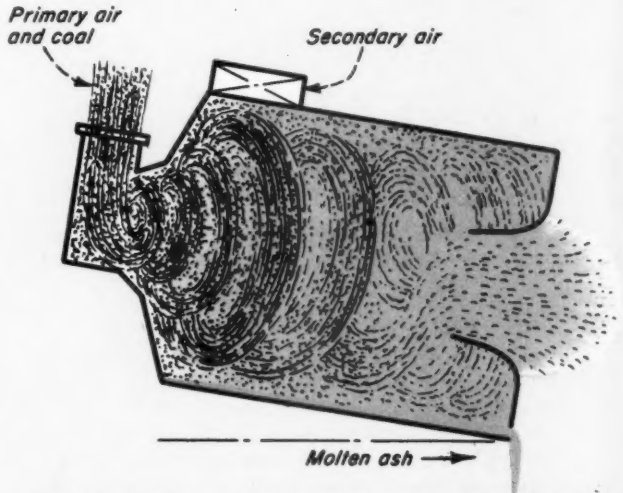
20 Vertical burners direct coal-and-air mix toward furnace bottom; help to increase travel and thus combustion time



21 This electric ignition unit with mechanical-atomizer oil burner has retractable electrodes and atomizing element



22 Movable firing nozzles aimed tangent to imaginary circle give turbulence; shifting flame area controls superheat



23 Cyclone burner whirls crushed coal against deliberately slagged walls, thereby removing a high percentage of ash

of handling more than one fuel. Many designs have been developed. Fig. 19 shows a unit for coal and oil in which primary, secondary and tertiary air, under separate control, are used for efficient firing. Many other combinations are available.

Ignition Equipment. Because these burners are designed to give peak performance at or near rated burning capacities and fall off at low loads, the problem of lighting off is a major one. Usually, an auxiliary oil or gas burner, electrically ignited, is employed for this purpose. The unit of Fig. 21 has a mechanical-atomizing oil burner. Both burner and igniting electrodes are retractable. In addition, a safety interlocking system prevents oil flow until burner and electrodes are extended.

AIR REQUIREMENTS

Having seen something of the form that pulverized-coal burners take, we're now ready to look at some of the relations between burner and preparation system, and between burner and furnace. Remember that today's unit system depends on air for drying, classifying and transporting the pulverized coal. When that transport air reaches the burner it becomes, willy-nilly, primary air unless it can be tempered or a portion bled off.

Air Supply. If amount of air needed for operations in the mill and that needed at the burner were the same, all would be simple. Each function performed by the air, however, has a ratio of air to coal that is best for that function. Hence some compromise is necessary. For example, amount of primary air for best ignition varies with the amount of volatile matter in the coal. Rule of thumb puts the percentage of primary air equal to the percentage of volatiles. With coals having a low-volatile content, volume of air needed for other jobs in unit systems may exceed that for ignition.

This, for example, is the case with anthracite. Successful unit-system burning of anthracite hinges on removing excess air from the transport system before it enters the burner to become primary air. Modern direct-fired anthracite designs thus *bleed* air.

Let's assume now that the burner delivers fuel and air in proper proportions for ignition. Here the furnace enters the picture, since it must supply heat sufficient to evaporate all moisture, distill all volatiles, and raise the entire mixture to ignition temperature. And it must do all this in as short a time as possible, so as not to take up too large a fraction of the available transit time, or furnace volume.

Heat for Ignition. With most coals, heat for ignition is no problem. Usually, the task is to remove effectively the large amounts of heat liberated and to handle the high temperatures resulting from radiation of incandescent fuel particles. Extensive watercooling is the answer. But with low-volatile fuels, particularly anthracite, the balance between heat removal and heat "reflection" must be carefully maintained. In furnaces for such fuels, it is customary to provide some refractory surface, strategically located to insure stable ignition.

Where does the burner figure in all this? In two ways: first in point of ignition and second in speed and completeness of mixing. Point of ignition depends on mixture velocity. As a lower limit, this must be greater than speed of flame propagation or, as we learned earlier in gas firing, flash-back may develop. As an upper limit, velocity cannot be so great that incoming mixture has time to become so lean or diffused with secondary air that furnace heat is not enough to ignite it.

Control of Mixing. The requirement of thorough, complete and rapid mixing of fuel and air is fundamental. But even beyond this is control of the mixing elements that affect flame travel. This control of flame travel touches on an inherent weakness in pulverized-coal firing—the difficulty of influencing the "tail" of combustion, as can be done in fuel-bed firing. It is for this reason that considerable attention is given to the problem of creating turbulence and aiding this turbulence by burner arrangement.

Combustible Loss. Even under the best of conditions, as combustion progresses unburned combustibles experience greater difficulty in finding available oxygen. For this reason, a high degree of turbulence becomes of prime importance where air and fuel keep constantly changing in physical relationship to each other. There is always a certain amount of combustible loss, the majority of which, in pulverized firing, goes up the stack. Its amount varies with percentage of excess air and ash content of the fuel. As ash percentage increases, percentage of excess air must also increase to hold combustible loss at a fixed level. Eventually it becomes a question of balancing loss in combustibles against dry-gas loss.

Ash and Slag. Ash enters the furnace picture in another way. Temperatures realized in burning of most coals are well above those at which ash fuses. Coal burned in suspension, then, has its ash content at one time or another in a molten state. It is highly desirable for the ash to be dry before it enters the gas passages of the steam generator. Transfer of heat from the suspended particles by radiation to the furnace surfaces is the only way of cooling the ash, and it takes time. Can it be speeded up?

Yes, fully watercooled furnaces absorb heat faster. But time for absorbing heat usually exceeds combustion time. This time, in suspension firing, is roughly equivalent to distance. So the distance between the burner and entrance to the boiler surface is a function of the time required for heat absorption. The magnitude of this time, or distance, is largely determined by ash content of the fuel.

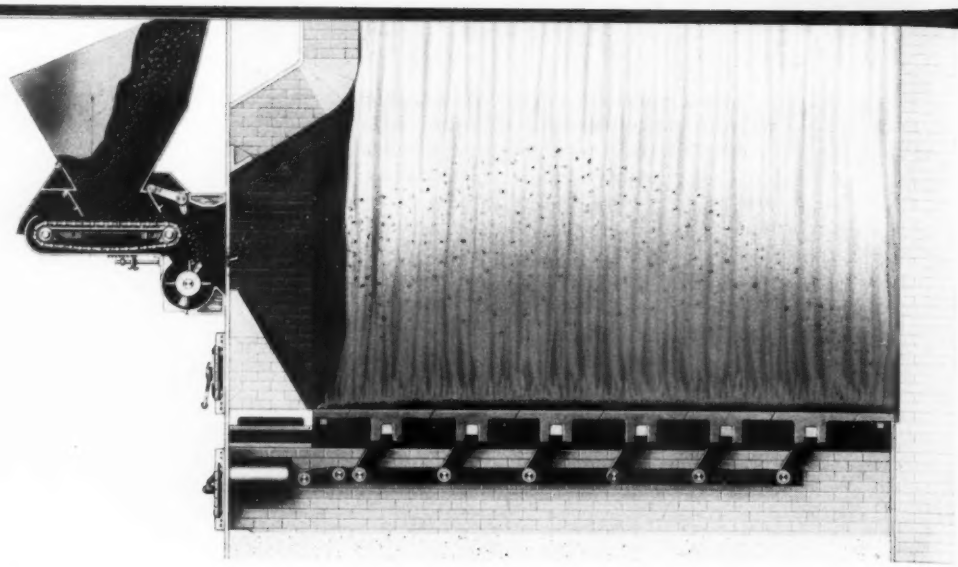
DRY-BOTTOM AND SLAG-TAP

Ash formed under good combustion conditions contains iron in a highly oxidized form and has a higher fusing-temperature range than indicated by laboratory conditions. Fineness of pulverization and good combustion reduce carbon content of ash and so tend toward higher oxidation of iron, thus helping to keep ash from slagging walls and tubes of *dry-bottom* furnaces.

Slag-Tap Furnaces. We may, however, elect to keep ash molten by use of a *slag-tap* furnace. Part of ash is removed from the combustion zone by directing burner flame generally downward over a pool of molten slag. These furnaces are suitable for high-heat releases, and tend to remove the low-fusion-temperature elements of the ash, so less slagging occurs on walls and tubes proper. Slag pool must be kept hot enough to remain molten so slag flows continuously over a water-cooled weir or ring into a quenching pit, where it is broken up by water.

Cyclone Burner. In this new furnace design, what might be termed "deliberate" slagging is employed. This burner, Fig. 23, receives crushed, not pulverized, coal in a stream of high-velocity air tangent to the circular burner housing, which forms a primary water-cooled furnace. Coal thrown to the rim of the furnace by centrifugal force and held by a coating of molten ash receives a vigorous scrubbing from fast-moving air. Secondary air enters at high velocity also, and parallel to the path of primary coal-air mixture.

It might be said that the coal in the sticky slag film burns as if it were in a fuel bed—volatiles are distilled off and carbon is burned out to leave ash. Combustion of volatile matter begins in the burner chamber, and is completed in the secondary furnace into which the burner chamber discharges. Molten ash, under centrifugal force, clings to the burner-chamber walls. Slight inclination causes slag to discharge continuously. Nature of this burning tends to reduce substantially amount of ash carried in suspension, hence flyash emission is negligible.



1 In spreader-stoker firing part of fuel is burned in suspension, part on a grate. Coal is projected across the furnace; fine particles burn during travel but the larger pieces fall to grate, forming an overfeed fuel bed on it. The stoker shown feeds coal by a chain to an overthrow distributing rotor, to be propelled into the furnace. The grate is arranged for dumping by steam, air or hydraulic operating devices

Burning Coal on

In terms of number of applications, fuel-bed firing takes the lead over suspension firing, the method of burning solid fuels we have just discussed. In modern practice, this means *stoker* firing, as mechanical methods have made obsolete less-efficient hand firing. Stoker operation, we have seen, consists of: (1) pushing, dropping or throwing coal on a grate within a high-temperature region of the furnace (2) distilling off part of the coal as a combustible gas (mostly hydrocarbons and CO), which burns above the fuel bed just like gaseous fuels (3) exposing the remaining red-hot solid, coke, to vigorous scrubbing by air coming up through the fuel bed until it is burned, and (4) removing the resulting ash from the furnace zone.

Stoker Types. Stokers accomplish these steps in a variety of ways, and the nature of the fuel bed may differ considerably in actual fact from the simplified bed with clearly defined zones illustrated on page 76. Stokers may be divided into two general classes, depending on the direction from which raw coal reaches the fuel bed: (1) *overfeeds,* in which the fuel comes from above, and (2) *underfeeds,* in which it comes from below. In turn, current overfeed designs may be divided into two broad groups: (1) *spreader* stokers, and (2) *chain-grate* or *traveling-grate* stokers. Let's look at the spreaders first, because their combination of suspension and fuel-bed firing forms a logical bridge from the pulverized-coal firing just discussed, and also because their fuel beds most closely resemble the idealized fuel bed set up for earlier basic consideration.

Spreader Operation. These stokers take raw coal (within definite size limits) and whirl it into suspension within the furnace by paddles or wheels, Fig. 1-7, or by air or steam jets, Fig. 8-10. The fines in the incoming stream of coal tend to burn in suspension during their travel across the furnace, while the larger pieces fall to the grate to form a fuel bed there. To a limited extent, then, spreader firing partakes of the characteristics of pulverized-fuel burning.

The fuel bed is normally rather thin but, since raw coal is distributed over it relatively evenly, it is not unlike the idealized fuel bed, with distillation, reduction, oxidation and ash zones one on top of the other. Actual thickness of the bed varies with steam demand and class of coal. Usually there is never more than a few minutes' supply of fuel on the grate. Underlying the thin, active fuel bed is a layer of ash. This, together with flow of air up through the grate, serves to keep metal parts to safe operating temperature. Air can usually be preheated to 300-350 F without creating a maintenance problem.

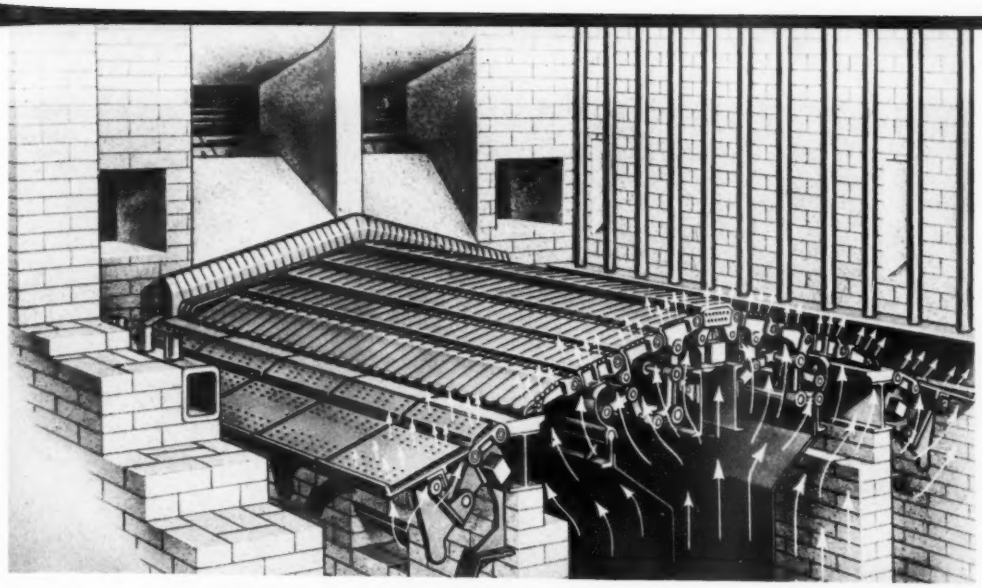
Underfire Draft. The characteristically thin fuel bed offers relatively light resistance to underfire air flow. Keeping resistance of the grates themselves fairly high and holding windbox pressure relatively low avoids heavy fluctuations as fuel-bed thickness changes, and also avoids heavy cinder carryover or, in extreme cases, blowholes.

Normal operation calls for relatively low overfire draft and gas velocity. This precaution becomes doubly important when it is realized that an estimated 30 to 50% of the coal's ash content may go off with the furnace gas.

As much as half of this carryover may be unburned combustible. Hence, installation of a cinder reinjection system often proves desirable. Such a system comprises settling chambers somewhere in the boiler setting and, usually, a cinder collector ahead of the induced-draft fan to save wear and tear on fan blades. Particles collected are fed to the furnace for reignition and burning. Returned cinder usually enters at a point above the fuel bed, but not too close to boiler tubes, under impulse of a jet. The jet gives added overfire turbulence and helps promote good combustion.

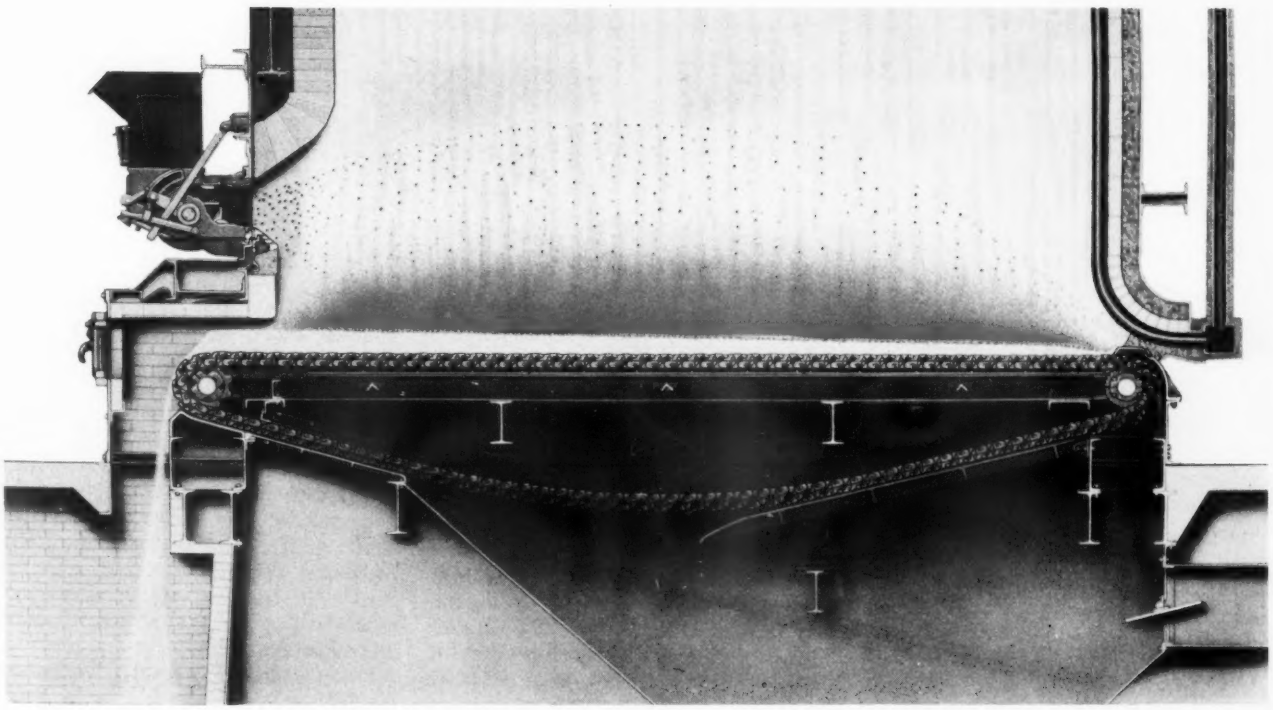
Furnace Design. Usual furnace arrangement follows simple lines with little or no arch construction. As with all fuel beds, composition of the gas released varies somewhat from point to point, and there is a tendency for gas, and secondary air, to take the most direct way to the furnace exit. High-velocity overfire jets prove effective in combating possible stratification. The turbulence they create not only improves mixing and increases time for combustion, it helps to reduce cinder carryover as well. Location of these jets should be worked out carefully, giving due consideration to relation to the coal's travel path.

Grate Arrangements. A variety of grate constructions are available and, by and large, plant operating conditions determine the most suitable one for any given installation. Simplest form is the



2 In this design, feeder rams supply coal to a spill plate where spring-loaded equalizer plate reciprocates at a right angle to it, shredding off fuel. Overthrow rotor spreads coal over central portion of grate, which has link construction to give a wave-like motion that keeps the fuel bed active and moving to ash-discharge grates. Dumping doesn't interrupt feeding

Overfeed Stokers

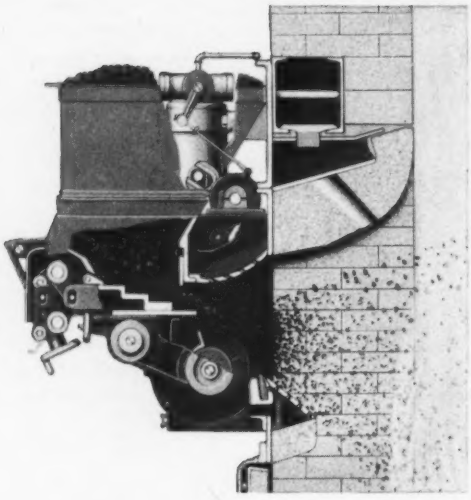


3 Revolving rotor takes coal fed from a hopper over a spill plate. This overthrow rotor hurls coal back over a chain grate which moves toward the furnace front. This movement of the grate makes ash-discharge continuous and fully automatic

stationary grate, which is cleaned manually. For dumping operation, grates are sectionalized so that one part of the fuel bed may be cleaned without affecting the others. In both, fuel feed stops during the cleaning operation. But the dumping arrangement minimizes the interruption by the sectionalizing feature and by the greater ease with which fire-cleaning may be carried out. Stationary grates prove entirely satisfactory in small plants, particularly where low-ash coal is used. Dumping grates find wide acceptance in somewhat larger installations.

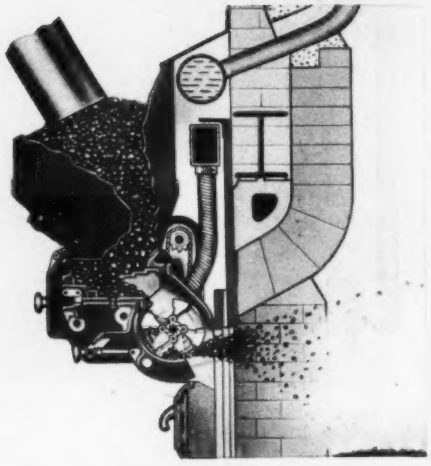
In the stoker of Fig. 2, coal is thrown evenly over the entire central portion of the grate. This is constructed to give a wavelike motion to the fuel bed, keeping it active and porous as it slowly moves toward the ash-cleaving discharge grates at either side. The hydraulically operated discharge breaks off the burned-out refuse and drops it to the ashpit. With this central firing and moving grate, there is no need to interrupt fuel feed during ash discharge.

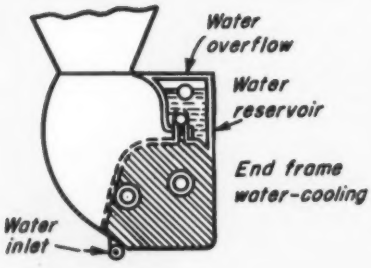
TYPICAL CONSTRUCTION DETAILS OF MECHANICAL SPREADER STOKERS



4 Sectional coal-feeder pushers, hydraulically driven, alternate in movement to deliver coal to overthrow-type rotor

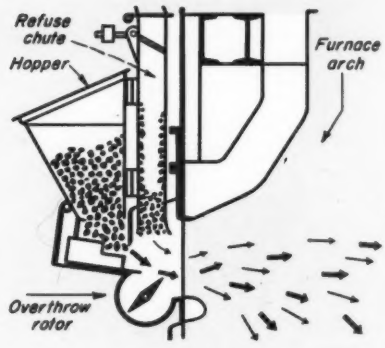
5 In this design, rotor has curved blades and projects coal into furnace by underthrow action





6 Detail shows a watercooled feeder. At top, reservoir extends across width; end frames have a cooled area

7 For firing waste fuels, this unit has separate hinged spout feeding refuse directly to an overthrow rotor



Unit of Fig. 3 has a traveling grate that moves forward slowly toward the front, or coal-feeding end, of the furnace. It discharges ash continuously. Such designs prove well suited to large installations, and have been applied to boilers with steaming capacities of 250,000 lb per hr. Some engineers believe much larger units can be built.

Coal Feeders. Spreader stokers can handle a wide range of coal types, including lignite. As to size, they do best on coals under about 1¼ in., with preferred size of the order of ¾x0-in. nut and slack. Coarse coal tends to wear the feeders and may form clinker.

Coal is usually withdrawn from a hopper by a mechanical feeding device whose role is to insure an even, uninterrupted supply to the distributing system. A variety of means is employed: a chain feeder does the job in Fig. 1; a set of feeder rams, Fig. 2; a double-acting ratchet mechanism and rotary feeder in Fig. 6; a hydraulic reciprocating-drive working sectional pushers in Fig. 4; a series of reciprocating plates working off the main lineshaft, Fig. 5. Still another example, Fig. 10, uses a worm. All have positive uniform feed as their objective.

Rotors. In mechanical spreader units, coal feeds down from the hopper to paddle or wheel-shaped distributing rotors. These move at high speed to throw the coal out into the furnace. There are two methods in common use, both of which claim advantages—overthrow and underthrow. They are so named from the point on rotor travel where incoming coal meets blades.

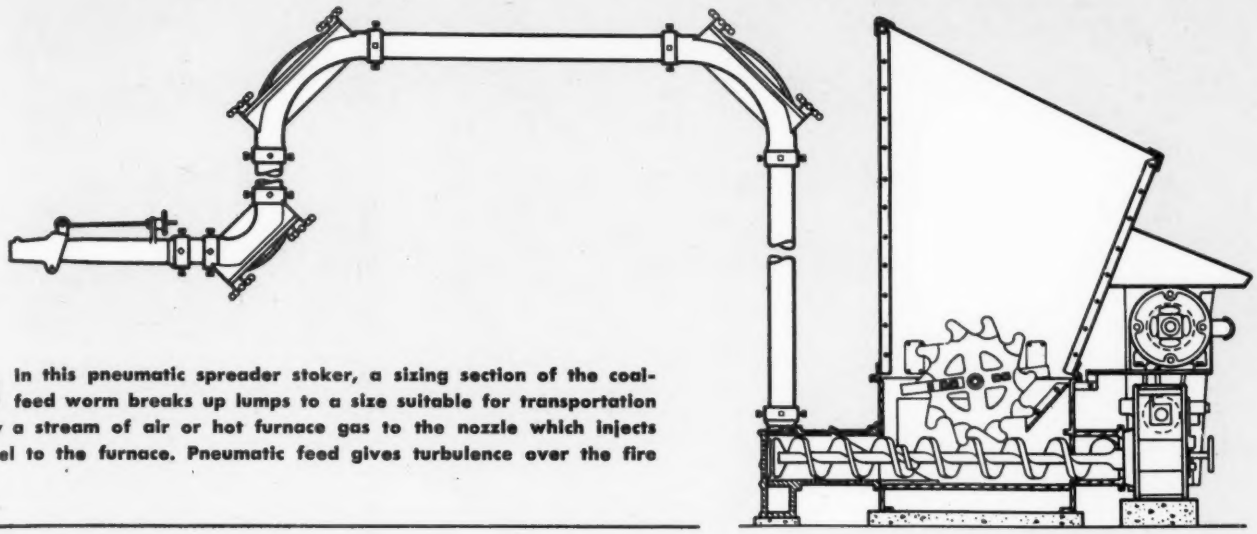
Overthrow. Fig. 1-4, and 7, show various designs employing the overthrow principle. Rotors, spaced to give desired coverage, are usually designed so individual paddles or elements can be readily removed and replaced. Feeder assembly provides means to correct for change in coal size to maintain desired distribution pattern. For example, the unit of Fig. 3 has a spill plate. When moved forward, it causes the rotor to throw more of the fuel toward the rear of the furnace, and when moved backward does the opposite.

Underthrow. Fig. 5 shows an underthrow rotor, which consists of small blades of special curvature, suspended loosely on shafts concentric to the main impeller shaft. Blades are designed to give a hammer-mill effect, breaking up any wet coal that tends to lump. In another design, the rotor is divided into sections, each having four blades at a slight angle to the shaft. Angles are such that one blade throws coal to the right, while the next throws to the left. This crisscrossing feed is designed to give uniform fuel distribution.

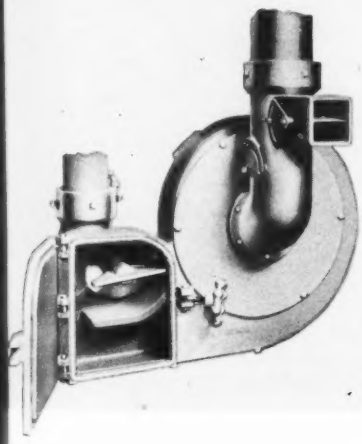
Watercooling is provided on many feeding and distributing assemblies. The detail of Fig. 6 shows one arrangement, with a reservoir at the top extending across the unit and cooled sections in each end frame. In many designs, the feeding machine and the grate section covered by it work together with an individually controlled air supply. The number of sections depends on furnace width.

An indication of the versatility of the spreader method of firing can be seen in Fig. 7. Here firing of waste fuels is provided for by the addition of a hinged chute, down which the refuse flows, under control of a gate. Both

THESE SPREADER STOKERS PROJECT THE COAL PNEUMATICALLY

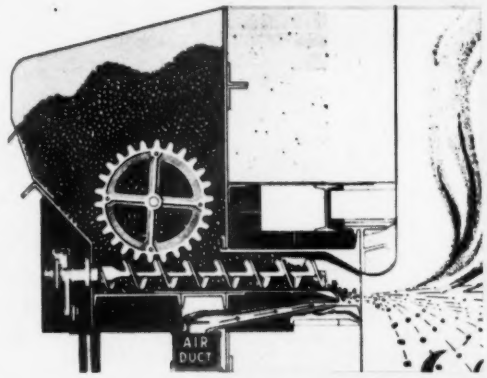


8 In this pneumatic spreader stoker, a sizing section of the coal-feed worm breaks up lumps to a size suitable for transportation by a stream of air or hot furnace gas to the nozzle which injects fuel to the furnace. Pneumatic feed gives turbulence over the fire



9 Detail of stoker above shows the transfer housing where feed worm discharges into outlet of radial-vane fan which gives high velocity to the transporting air (or hot furnace gas)

10 In this pneumatic stoker, agitator wheel in hopper prevents piling up of coal on screw feeder. Coal from feeder falls into path of an air stream which projects it into furnace



coal and refuse are distributed over the grate by an overthrow rotor. A series of stepped shoes set on a sharp slope, and moved by rocker action, feeds the coal.

Pneumatic Spreader. A different method of spreader firing is shown in Fig. 8 and 10. These units employ a jet of steam or air to project the coal into the furnace. The unit of Fig. 8, which features a remotely located feeding mechanism and hopper, can readily be arranged to feed directly from a bin or bunker. Coal in the hopper moves slowly down to a feed worm, which has a sizing section to break up lumps too large for transport by pneumatic means. The worm carries the coal in a loose state to the transfer housing, Fig. 9. Here a stream of air from a high-pressure radial-vane fan picks it up and conveys it through a pipe to the burner nozzle. Hot gas from the furnace may be used as the transporting medium, if so desired.

The spreader nozzle is wedge shaped; front and back distribution is regulated by elevating or depressing the nozzle tip, and side distribution by movable wedge blocks in the tip. A low-pressure fan supplies air for combustion. Separate motors drive feed screw, conveying-air fan and combustion-air fan. Variable-speed transmission adjusts rate of fuel feed and an air-volume regulator maintains desired air supply.

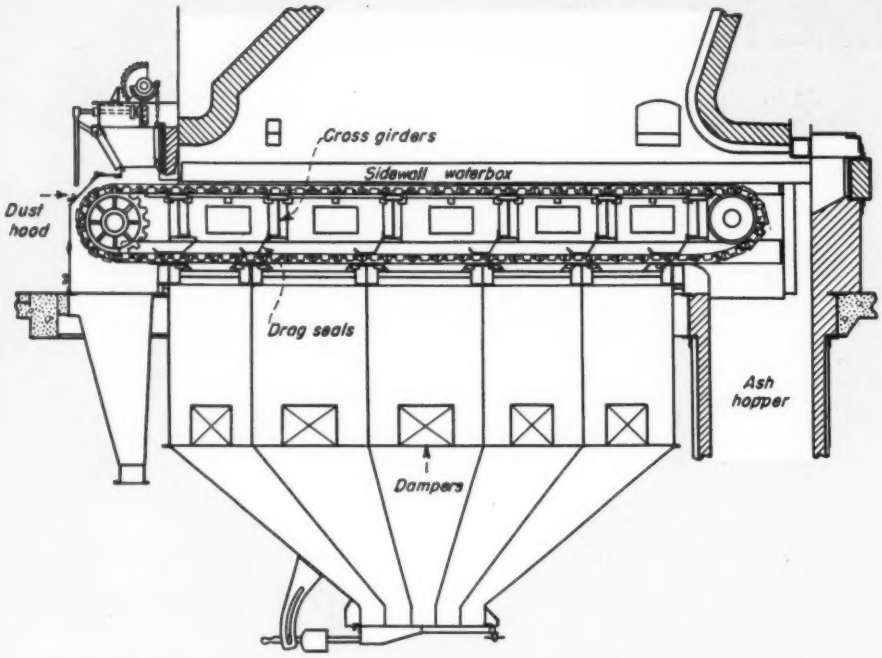
Another Pneumatic. In the design of Fig. 10, feed screws spaced across the width of the stoker move coal from the hopper to the point of injection. An agitator wheel in the hopper prevents coal piling up on the screw. An air jet set just below the end of the screw catches up the coal as it falls and spreads it over the grate. At the same time, this air jet provides an overfire air stream.

Spreader Drives. Many feeder mechanisms are motor driven, with some form of variable-speed transmission to control rate of fuel feed. Usually a steam-turbine drive, and sometimes a hydraulic drive, can be applied. Dumping grates may be hand operated or powered by steam, air or hydraulic cylinders. Moving grates used for continuous ash discharge are powered by motor, with variable-speed transmission, and by hydraulic drives, with a constant-speed variable-displacement pump supplying fluid to a constant-stroke variable-speed hydraulic motor.

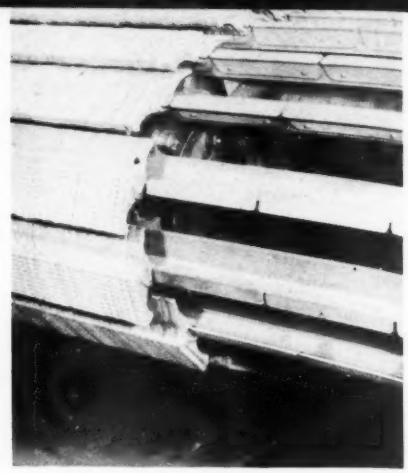
The stoker of Fig. 2 has an integrated hydraulic drive that serves all parts, and provides automatic fuel-air ratio control. A single pump, driven by a constant-speed motor (or turbine) supplies oil to a hydraulic motor driving the rotors, and hydraulic engines actuating moving grates, ash-discharge grates and feed rams. Fuel-air ratio control acts on proportioning valves in the discharge from the pump, regulating flow to the various drives and relief to the oil tank.

The spreader stoker has come into wide use in recent years because it is relatively simple, low in first cost, and insensitive to coal characteristics. With proper controls and provisions for holding cinder carryover to an acceptable level it gives highly satisfactory service under a wide variety of conditions. It has a reputation for quick response to load changes which is,

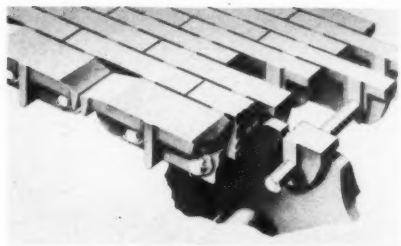
CHAIN GRATE: BOTTOM AIR DISTRIBUTION



11 **Chain-grate stoker with bottom air distribution: dampers in individual compartments regulate air flow to each grate section from front to rear**



12 **Rear of traveling grate shows grate-clip overlap to reduce the siftings**



13 **Detail of chain-grate construction shows how it differs from one above**

however, dependent on maintenance of a thin, level fuel bed.

Chain and Traveling Grates. The grate in these stokers resembles nothing so much as a wide belt conveyor, moving slowly from the feed end of the furnace to the ash-discharge end. Coal feeds from a hopper under control of a gate, which establishes fuel-bed thickness. Furnace heat ignites coal and distillation begins. As the fuel bed moves along slowly, the coke formed is burned and the bed gets progressively thinner. By the time the far end is reached, nothing remains but ash, which falls off the grate as it goes around the end sprocket to begin its return journey underneath.

Grate Construction. Chain grates were originally developed for bituminous coal, and traveling grates for small sizes of anthracite. Structural details differ, but these units perform the same functions, often side by side. As the name implies, the chain grate is in reality a wide chain, with grate bars forming the links. Links are staggered, Fig. 13, and connected by rods extending across the stoker width. In the traveling grate there is a drive chain at each side with crossbars at intervals. The fingers, keys or clips that form the grate surface are attached to these crossbars. They overlap, Fig. 12, to prevent ash sifting through.

It can be seen that stokers of this type are true overfeeds, but the fuel bed differs considerably in appearance from the idealized one shown on p 76. At the feed end, we have virtually all raw coal, with ignition beginning in the top layer. Further along the stoker, distillation has progressed and we have active burning. Then, as distillation is completed, we come to an area where carbon is being burned out and, at the end, we have nothing but ash. Thus, although the steps in the burning process are the same, the location and shape of the various zones differs markedly from the idealized version with clear-cut zones one above the other.

Ignition. With this method of firing on a moving fuel bed, rate of ignition tends to control grate speed and fuel-bed thickness. Otherwise, available time within the furnace may be too short for complete combustion, or too long to permit full use of the grate.

It is radiation, in the main, that ignites incoming fuel. Once the surface layer ignites it warms coal beneath by contact. If the rate of air flow through this part of the fuel bed is about right, surrounding coal ignites in short order. If air flow, including leakage, is far more than needed, overall result is cooling of the fuel bed and a slower ignition rate.

It can be seen that for best results air-flow rate will differ along the grate, as the burning progresses, and that the gas coming off the bed will differ markedly in composition from feed end to ash discharge. From this point of view, there are three broadly different sections: (1) The part where most volatile matter is distilled off, usually early in the grate's travel. Furnace atmosphere in this region is a reducing one — the gas is rich in combustible volatiles but poor in air. (2) The active burning area, where mixture of air and combustibles comes closest to the ideal. (3) The rear zone where the last chance for burning carbon occurs. Gas from this is usually lean—heavy with excess air.

Air Distribution. Amount and control of air is highly important. So, too, is control of leakage around the grate. Should this occur at the combustion-chamber level it breaks down the pressure difference across the fuel bed. This drop in "pull" through the bed lowers the ignition rate. In units with forced or induced draft, such leakage puts a heavier load on the fans. For this reason, considerable attention is given to sealing arrangements.

To take care of differing air requirements and fuel-bed resistances along the grate length, the stoker is zoned or sectionalized, with a damper in each section to regulate air pressure. Air for combustion can enter from the bottom through both grates, Fig. 11, or from

the side between top and bottom grates, Fig. 14. In the latter, three typical damper and seal arrangements in side-admission units are illustrated.

The difference in composition of the gas coming off the fuel bed calls for definite measures to avoid stratification and insure thorough mixing.

Arches. Earliest and still commonest device for mixing is the furnace arch. Furnace layouts have traced a long pattern of development. Early designs featured a long front arch to reflect heat to the incoming fuel for quick ignition and to direct rich gas from the front end toward the rear. The rear arch has gradually become more prominent, and the front arch shorter. A typical arch design of today, Fig. 15, has a modest front arch, a long rear one, and a relatively narrow "throat" between them. The rear arch directs the lean gas forward and the narrow throat promotes mixing. The excess air from the rear end thus helps to supply the air deficiency of the rich gas from the front end and thereby reduces over-all excess air.

Overfire Jets. Some designers prefer a relatively open furnace with only a short front arch, and depend on high-velocity overfire jets to produce the turbulence and mixing required. They reason that arches as mixing agents give best results at design rating, whereas the jets give positive mixing over the entire load range. A number of such "open" furnaces have been installed and results seem favorable.

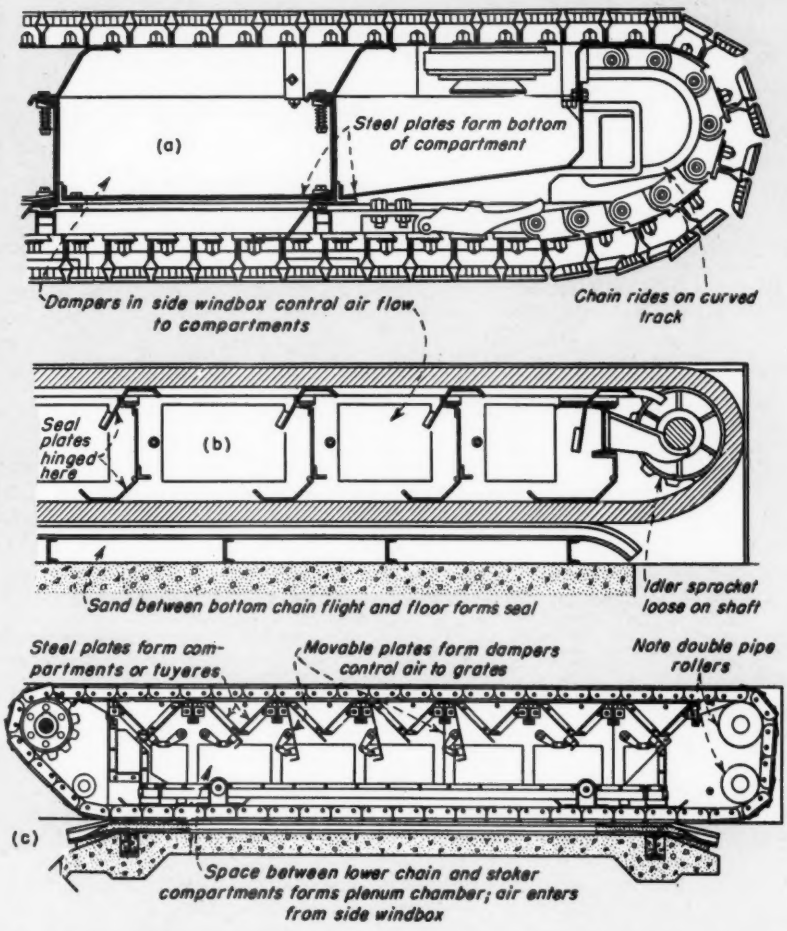
Stoker Drives. Drive can be applied at either front or rear end. A worm and wheel or gear and pinion provide the necessary speed reduction. Power unit can be a constant-speed motor with variable-speed transmission, a turbine or a steam engine.

Chain- and traveling-grate stokers, as a class, have long been considered well suited for high-ash free-burning coals. The reasoning behind this is that the fuel moves in one plane, relatively free from agitation. Coking coals, it is felt, tend to mat over, cut off air supply, and increase fuel-bed resistance.

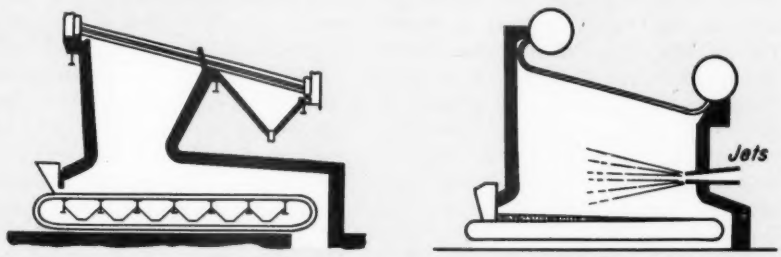
Proper selection of coal size and size consist goes a long way toward assuring satisfactory operation. With natural furnace draft of about 0.1 to 0.15 in., coal having a top size of 1¼ in. and little fines below ½ in. gives good results. Heavier draft permits coals of 1½-in. top size, having the range of fines naturally occurring in crushing.

Forced-draft chain grates have about 7 to 10% air space in the grate as contrasted to about 20% for natural-draft units. So coals with an increased percentage of fines and a smaller top size (¾ to 1 in.) can be burned satisfactorily with forced draft.

SEALING OF GRATES, TYPICAL FURNACES

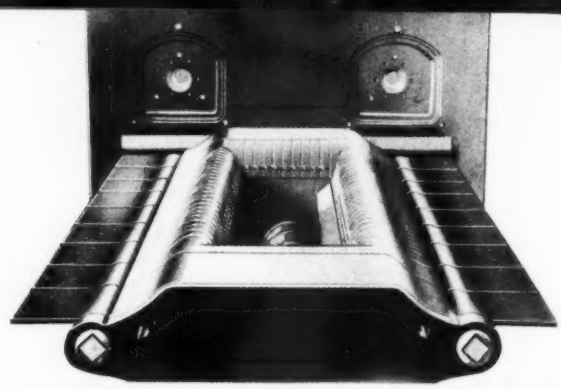

(a)
Steel plates form bottom of compartment
Dampers in side windbox control air flow to compartments
Chain rides on curved track
Seal plates hinged here
(b)
Idler sprocket loose on shaft
Sand between bottom chain flight and floor forms seal
Steel plates form compartments or tuyeres
Movable plates form dampers control air to grates
Note double pipe rollers
(c)
Space between lower chain and stoker compartments forms plenum chamber; air enters from side windbox

14 Air requirements differ as fire moves from front to rear. Where air is admitted at sides, various methods are used to zone air flow accordingly. At top, cross members and steel bottom plate form tight compartments. Middle design has seal plates hinged from cross members and resting on lower grate. In bottom unit, space between grates forms plenum chamber with dampers above



15 Gas at stoker front is rich, at rear is lean. This makes good mixing vital. Arches may be used to direct flow or furnace may be open, with jets

Compensating Feed. One overfeed stoker employing a moving grate operates on what is known as the compensating-feed principle. The grate is made up of alternate moving and stationary sections that run the full length. Grate is inclined. Moving sections occupy the greater area. Over the grate surface at the rear are cover plates designed to retard ash flow and give a tight rear-end draft seal. As coal moves progressively down the grate, impelled by the moving sections, the stationary sections retard movement and build up a compression force. When cracks and fissures develop this force relieves itself by shifting coal into the open areas of the fuel bed.



2 Air-cooled side-dump grates afford final air supply for any unburned coal, and cut down losses from this source

1 Single-retort underfeed stoker has screw feed; the retort is surrounded by dead plates, with tuyeres recessed below

Burning Coal on

As the name implies, in *underfeed* stokers raw coal comes to the fuel bed from below. It is pushed along in a feed trough, or *retort,* and, under pressure of fresh coal behind, it rises in the retort to spill over onto the fuel bed at either side of it. No air is supplied in the retort proper; it comes through openings called *tuyeres* in the grate sections adjoining the retort. At the retort top, raw coal is exposed to some drying action from incoming air, and to furnace heat. Ignition occurs and distillation begins as the coal moves from the retort area to the active burning area around it. Either under pressure of incoming coal, or as a result of grate motion, burning coke moves slowly to ash-discharge area.

Underfeed Types. *Single-retort* units can handle up to about 25,000 lb per hr steaming capacity, occasionally as high as 40,000. Fig. 1-4 illustrate stokers of this type. *Twin-retorts,* Fig. 5, are also employed. For capacities from about 30,000 lb per hr up to more than 500,000, *multiple-retort* designs, Fig. 6-12, may be employed.

Single-retort stokers differ in method of feeding coal and in the grate arrangement. In the smaller size ranges, coal is propelled into the retort by a worm or screw, while in larger units a ram, possibly aided by pusher blocks or a sliding retort bottom, does the job. Simplest grate design employs stationary sections which are cleaned manually. When no air is admitted through them, these are called *dead plates;* when air is admitted they are sometimes called *live plates.* In either case, main air flow comes through tuyeres around the retort top.

Screw Feed. Fig. 1 shows a screw-feed unit with dead plates surrounding the roughly square retort area. The tuyeres are recessed below the dead plate level. In other designs, tuyere blocks are high and slope away from the retort. Sectional tuyere blocks allow for expansion and make replacement easy. Screw-feed stokers with stationary grates find application for coal-feeding rates from as low as 100 lb per hr and up to about 1200. Stoker, draft fan and controls may be designed and sold as a unit.

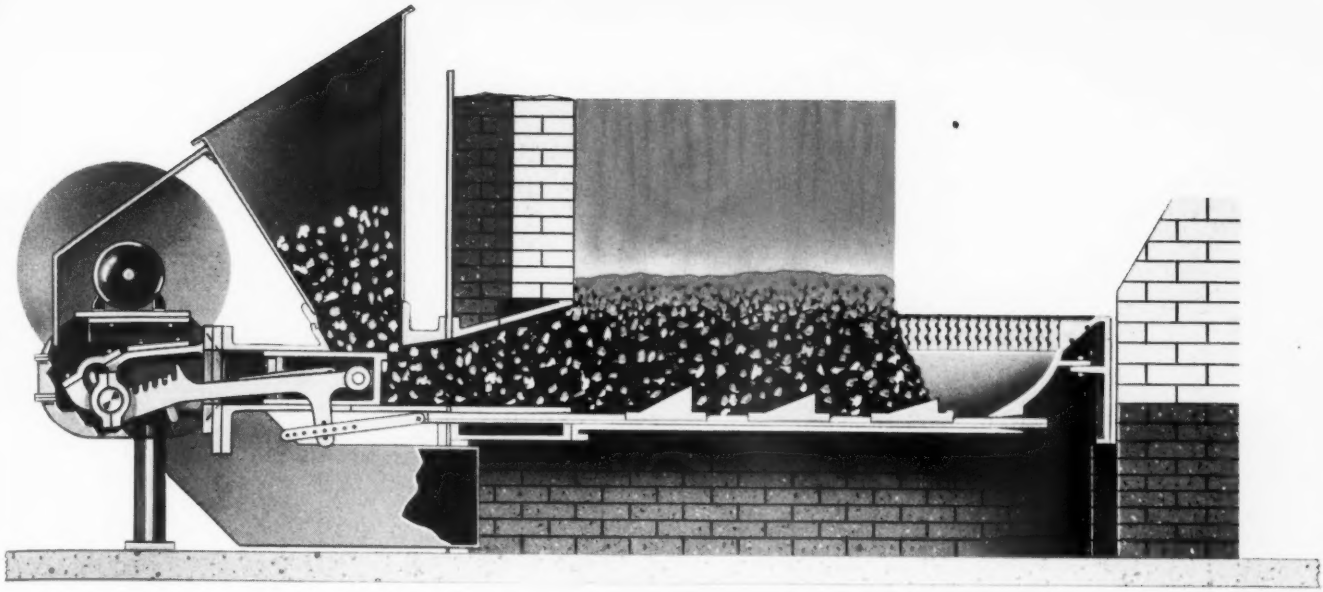
Dumping Grates. In larger units, retorts are longer and dumping grates are applied at the sides. Fig. 2 shows such a design looking toward the front end. Extended tuyere sections form live grate areas at the sides of the retort. The ash grates dump into collecting pits from which ash is removed manually at intervals.

Many screw-feed stokers are powered by constant-speed motors, usually with a mechanical transmission for speed reduction and adjustment. Hydraulic transmissions are sometimes used. Where automatic control is applied it is frequently of the "on-off" type, with a hold-fire arrangement.

Ram Feed. The ram-feed single-retort stoker overlaps the screw feed at the lower end of its size range. But, as mentioned before, some designs serve boilers of 25,000 lb per steaming capacity, and higher.

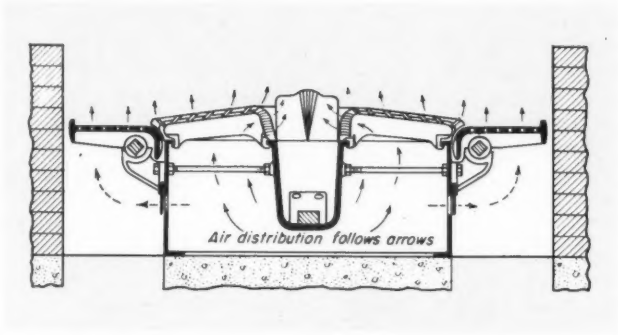
The ram, piston, or plunger, as it is variously known, connects by a crank to a driving mechanism or to a steam, air, or hydraulic cylinder in some designs. Ram stroke usually stays constant; change in timing varies fuel feed. The ram pushes the coal to the retort area. For distribution in longer retorts a variety of means are employed. Some units have sliding retort bottoms while others have pusher blocks that reciprocate slowly. These devices usually drive from the same mechanism as the main plunger. Ram and pusher strokes are usually adjustable. In addition to distributing coal in the retort, auxiliary pushers provide an additional measure of fuel-bed agitation. Fig. 3 shows a typical ram-feed stoker with pusher blocks.

Grate Motion. Many single-retort units have moving grates to provide fuel-bed agitation and to assist move-

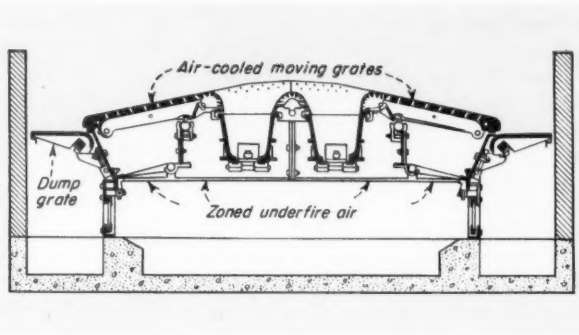


3 Gravity-fed coal from hopper reaches a reciprocating ram, moving under action of crank. Ram feeds coal into retort where pusher blocks help distribute it to the fuel bed. Burning coal moves out over tuyere section to ash grates at sides

Underfeed Stokers



4 Section through single-retort unit with side-dump grates; arrows show how air flows through tuyeres and grate areas



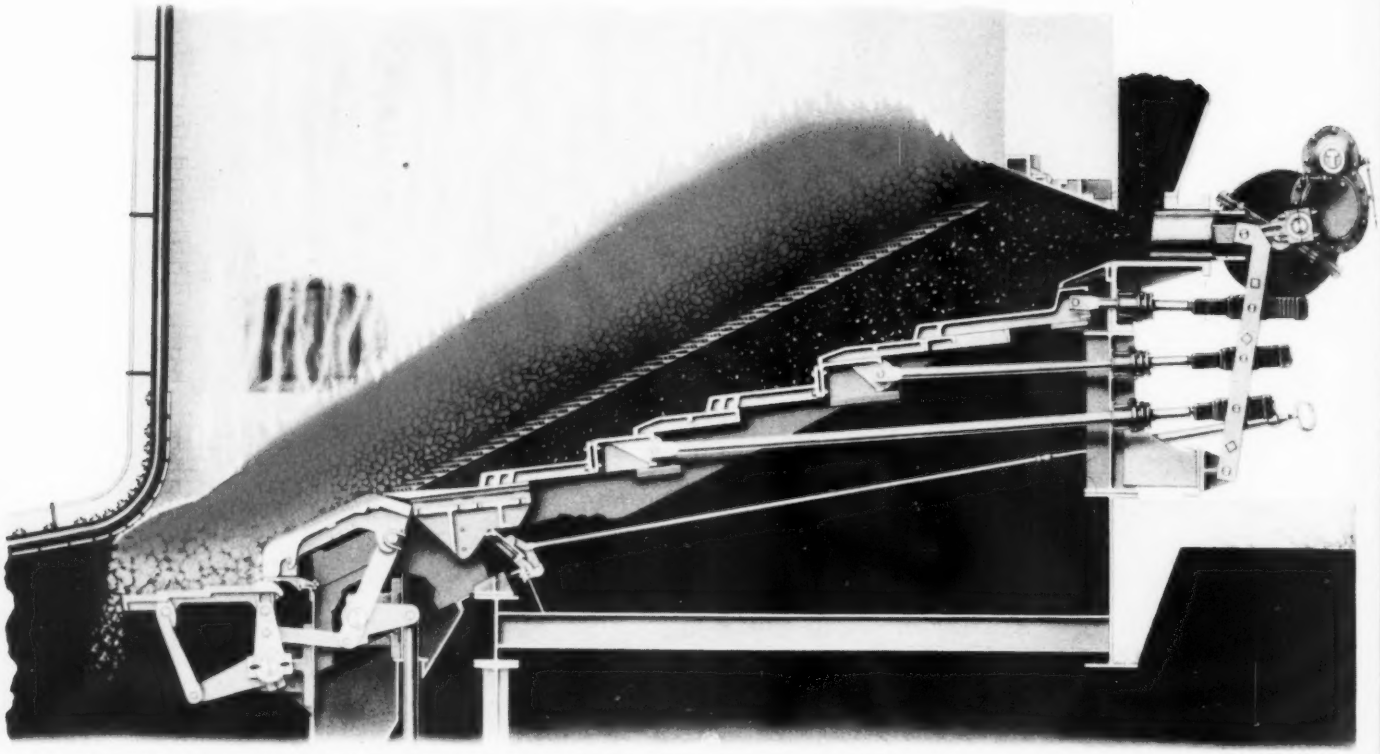
5 Section through an underfeed stoker with twin retorts; an air-cooled oscillating grate provides fuel-bed agitation

ment of the coal to the dump grates at the sides. Methods of providing this motion vary. In some units, alternate grate bars move laterally, actuated by a rocker arm or camshaft driven from the main drive mechanism. In one design, Fig. 5, side grates consist of a series of bars grouped along the long axis of the retort. Two or more rows of bars may form the grate area, depending on furnace width. An oscillating shaft imparts motion directly to these grates, with maximum movement near the retort.

Air Distribution. Side grates and dumping grates are usually provided with air holes to extend the active burning area. Air in quantities and at pressures suitable to fuel-bed conditions is supplied from a main air chamber with dampers providing control of distribution to various grate sections. Some units have hollow grate bars through which air passes from the main chamber to auxiliary chambers. This cools grate castings and provides some air preheating.

Having seen some of the construction features, we can now form a better picture of single-retort operation. Under action of the feed screw or ram, coal enters the retort, being pushed rearward and upward. It moves slowly over the retort edges and spreads out over the active grate area. It is first exposed to air and furnace heat at the top of the retort zone. Here some drying occurs and ignition and distillation begin. Normally, ignition occurs about as the coal reaches the boundaries of the retort area and, except in narrow stokers, the only active burning occurs on the side grate sections.

As the coal moves slowly to the sides (and rear in many small units) all volatiles distill off to leave coke, which is burned out as the edges of the unit are approached. Most of the incoming



6 **In multiple-retort underfeed stoker, rams, followed by adjustable-stroke secondary pushers, feed coal into inclined retorts. Coal spreads out over grate sections between retorts; air comes through tuyeres in them. Final section is overfeed**

air goes up through the fuel bed close to the retort area, Fig. 4. At this point it serves the useful purpose of promoting rapid ignition and maximum mixing between air and volatiles released from heated raw coal. In some installations, overfire jets are employed to give high turbulence.

It is characteristic of this type of firing that some clinkering should occur and fuel-bed agitation breaks up such clinkers and coke masses as form. Use of a coal having a lower ash fusion than that suitable for the design of a given unit may lead to clinkering difficulties, especially along the sidewalls at the grate level. Watercooled sidewalls reduce such tendencies and thus help to extend range of coals burned satisfactorily and also the continuous capacity rating.

Coal Characteristics. Single-retort underfeed stokers handle most bituminous coals, and anthracite. Size is not too critical, but preferred choice limits top size to from ¾ to 2 in. Usual specifications call for 2-in. nut and slack with no more than 50% through a ¼-in. round-hole screen. Reduction of the percentage of fines promotes flexibility by extending possible choice of coals. The desired aim is, of course, to get a coal size-consist that gives rapid ignition and a porous and uniform fuel bed. Where single-retort stokers equipped with stationary grates are used, a double-screened coal is advisable to reduce percentage of fines.

The fuel-bed agitation of underfeed firing makes it suitable for caking coals. Amount of agitation varies with stoker design; hence selection of coals with caking characteristics suited to the degree of agitation obtained is important. Also to be considered is the matter of ash-fusion temperature previously mentioned.

Multiple-Retort Stokers. The multiple-retort underfeed stoker is a logical development of the single-retort idea. There are many special provisions and practices that apply, however, only to multiple-retort designs.

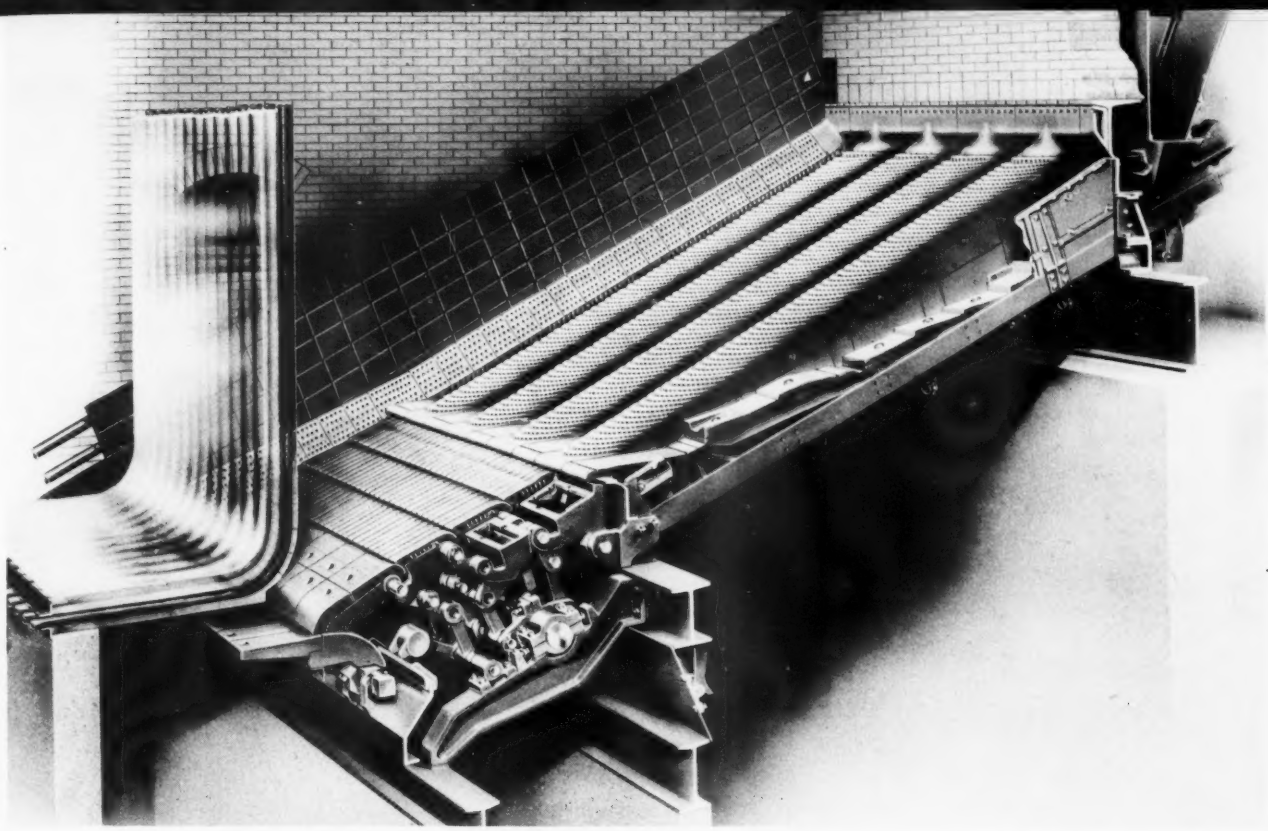
As the name implies, multiple-retort stokers consist of a series of inclined feeding retorts extending from front to rear of the stoker, with tuyere sections between them, Fig. 7. Rams push coal into the front end of the retorts, below the point of air supply, which is through tuyeres in the grate sections between and at the top of the retorts. Incoming green coal gradually forces its way up under the fire. Secondary pushers move the whole mass slowly to the rear. Usually there is an overfeed section where burning is completed before ash discharges.

Fuel-Bed Contour. In the underfeed section, a sort of hill-and-valley contour characterizes the fuel bed. The slight hills are directly over the retorts, which are the supply channels for the incoming coal and have virtually no flow of air through them. The tuyere sections display an opposite condition. Almost all incoming air passes through them and only lateral flow from neighboring retorts feeds coal over their surfaces. The relatively thin sections of fuel bed over the tuyere zones form a series of parallel active burning lanes down the stoker length.

The hill-and-valley contour becomes less marked at the lower end of the bed and the active burning lanes tend to widen until on the overfeed section the active area extends more or less uniformly across the entire stoker.

Overfeed Action. In the underfeed part of the bed, the early coking and plastic stage occurs, by and large, over the retorts. High combustion rates on a thin and active fuel bed characterize the action over the tuyeres. Because of this difference in fuel-bed thickness and character over retorts and tuyeres, the overfeed extension-grate section is important for shaking down and leveling out the fire to give a uniform bed in which the final stage of burning out the coke can be completed. As we will see later, a variety of means are employed to achieve desired action in the overfeed section.

Air Distribution. As previously mentioned, air for the underfeed section comes through the tuyere blocks. Quantities and pressures needed along this section differ somewhat and those required for the overfeed section, where



7 **Tuyere sections and retorts alternating across stoker show clearly here. Cutaway reveals feeding-ram action. The rear end of this stoker is an overfeed link grate, having a wave-like action that is synchronized to rate of feeding the fuel**

fuel-bed resistance is generally less, are also different. Windbox dampers are used to take care of these differences. In some large units, extensive zoning of air supply, with gages for measuring pressure in each zone, has been provided so air supply and pressure can be controlled to meet variations in fuel-bed resistance across the width and along the length. Such complete control of air distribution is reported to give: (1) higher practical burning rates (2) lower maintenance of grate castings (3) increased efficiency because of lower excess air, and (4) elimination of smoking tendencies.

Air Preheat. Modern practice generally accepts preheated underfire air as desirable. It permits higher ratings, and a moderate preheat materially increases the output range. On the other hand, excessive preheat causes burning back into the retorts with consequent greater maintenance of the grate castings. Holding preheat temperature to about 250-300 F represents conservative practice.

Having seen some of the general characteristics of multiple-retort firing, we can turn now to constructions.

Stoker Drives. Looking first at the drive mechanism, we find that type employed depends to some extent on load conditions. These fix peak and low-load firing rates and rapidity of fluctuations, hence the type of drive and control to give desired flexibility. Where only a narrow speed range, with few intermediate speed points, is needed, multi-speed motors find acceptance. Variable-speed transmissions extend the speed range and number of intermediate positions. Steam engines and turbines give flexible speed characteristics and are often employed because of heat-balance conditions.

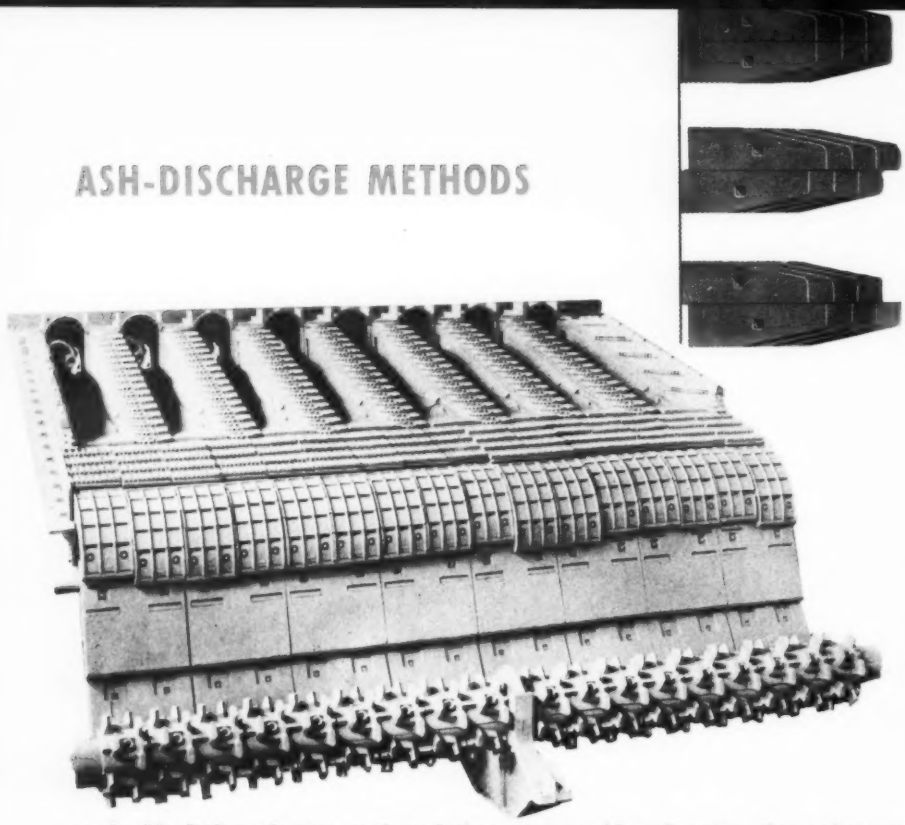
Hydraulic Systems. Two basic types of hydraulic drive have found general use. In one a constant-speed motor drives a variable-displacement oil pump which delivers varying quantities of oil to a constant-displacement oil motor. This variable-speed unit drives the stoker. In the other type, oil from a pump acts directly on hydraulically actuated coal-feeding rams. Hydraulic systems give wide speed range with infinitely variable adjustment.

The stoker of Fig. 6 has different drives for the front end and the overfeed extension grate. Front-end drive employs a planetary spur-gear power box for transmission from a constant-speed motor to the coal-feeding mechanism. Connection between drive and rams and between secondary pushers and pusher-actuating levers is designed to give essentially straight-line action. Both ram and pusher strokes are adjustable. The extension grate and ash-discharge plates of this design move as a unit, independent of the main drive. An automatically timed hydraulic cylinder moves grates up and forward to push ash onto the discharge plate.

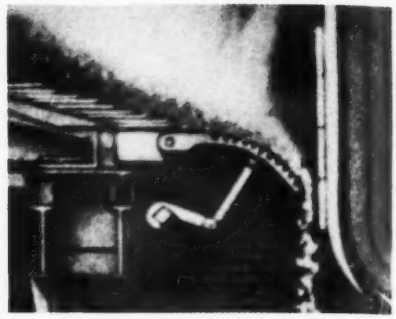
Turbine Drive. The stoker of Fig. 7 can be driven by either a turbo-gearbox, designed for steam service, or an adjustable-speed ac motor drive, where electricity is the choice. The turbo-gearbox is a small turbine built integral with the stoker gearbox. A single turbo unit serves the stoker, with standard gearboxes serving each ram and pusher group. Under control of an oil governor, this turbine drive operates over a 10 to 1 speed range.

The electric drive employs a self-excited series-wound dc generator driven by an ac motor to furnish power to a standard series-wound dc motor. This unit mg set can be mounted in any position and gives simple, reliable speed adjustment over a 10 to 1 range. With both types of main drive, link-grate overfeed section is separately driven, in most cases by a hydraulic cylinder.

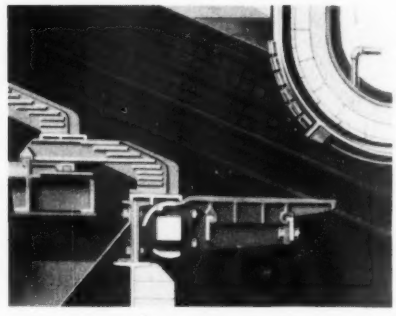
Gearboxes. In usual practice, coal-feed rams operate from crankshafts driven through gearboxes. One such box may drive three or more rams. Wide stokers thus may have two or more gearboxes, which permits changing coal-feeding rate over part of the width. Usual arrangement has two speeds and neutral. Mechanism may be a spur-gear planetary drive without a clutch, or a spur-gear train or worm-and-wheel with a clutch.



8 In this design, plungers push coal along retorts; sides of retorts also reciprocate (see detail, upper right). Clinker grinder can be seen at the discharge end



9 Rocker dump plates discharge part of ash steadily; lengthen dump interval



10 These dump grates are normally horizontal. Overfeed bars move ash

Rams and Ram Boxes. These may be horizontal or inclined at the angle of the grate surfaces. Most rams are cylindrical; some are tapered. In most units, construction of ram box and plunger is such that wearing parts can be renewed readily. This usually means replaceable liners for the ram boxes.

Rams and secondary pushers (1) move the fuel bed at the proper rate from front to rear, and (2) provide for changing rate of feed and motion at different parts of the fuel bed as thick or thin spots develop.

Fuel-Bed Motion. These functions may be accomplished in a variety of ways. A common solution depends on secondary rams or pushers in the retorts, driven from the main rams or directly from the stoker drive. Stroke of pushers may be adjusted individually or in groups to control local fuel-bed conditions.

A variation of this arrangement features sliding retort bottoms with auxiliary pushers mounted in them. Adjusting the motion of the sliding bottoms controls fuel distribution. Fig. 8 shows a different method. Here the retort sides, made up of half the tuyere stack split lengthwise, reciprocate. Tuyere blocks, overfeed grate sections and rocker dump plates work together from common sidebars, two to a retort. These sidebars are, in turn, connected to the main plungers and move with them. This reciprocating surface gives a decided agitation to the fuel bed. Changing sidebar travel controls general fuel-bed conditions.

Extension Grates. Only ash and coke remain when the underfeed section has completed its work. To burn this coke efficiently and thoroughly requires uniform air distribution at lower pressures. Extension overfeed grates meet this requirement. The extension section usually has a reciprocating action and may be driven separately or from the pushers. Moving and stationary surfaces are variously disposed and may be flat or stepped.

Overfeed section of Fig. 7 consists of three or more links of narrow bars set in frames that correspond in width to the center-to-center distance between tuyere rows. Upper link pivots on lower end of the underfeed section. Rocking motion of the drive shaft imparts an undulating motion across the grate width that keeps the fuel bed active and porous as it moves down to the dumping grates.

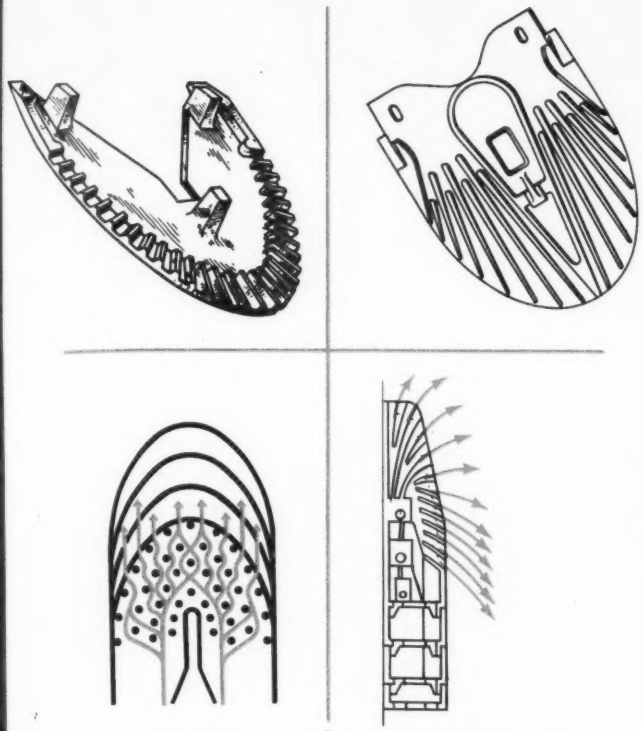
In the design of Fig. 8, the extension grates work from the sidebars previously mentioned. Since adjacent halves of each grate section reciprocate in opposite directions, a shearing action is set up that tends to break up any clinker formations.

Ash Discharge. In the majority of multiple-retort stokers, some form of dumping grate is employed for ash removal, often designed for continuous discharge. For continuous discharge with refuse sizing, clinker grinders are employed. Character of coal, stoker size, and nature of load influence selection of ash-discharge method. The simpler dumping grate installation is commonly found in small or medium-size units burning relatively low-ash coal. In large installations meeting continued high-capacity steam demands, and particularly where ash-content of coal runs high, continuous-discharge designs and clinker grinders are used.

Dump grates are usually pivoted at the ends of the overfeed section and arranged so they may be lowered at intervals to dump accumulated ash and clinker into a pit. They may be operated by hand, or steam, air or hydraulic cylinders. Some have openings for admitting air.

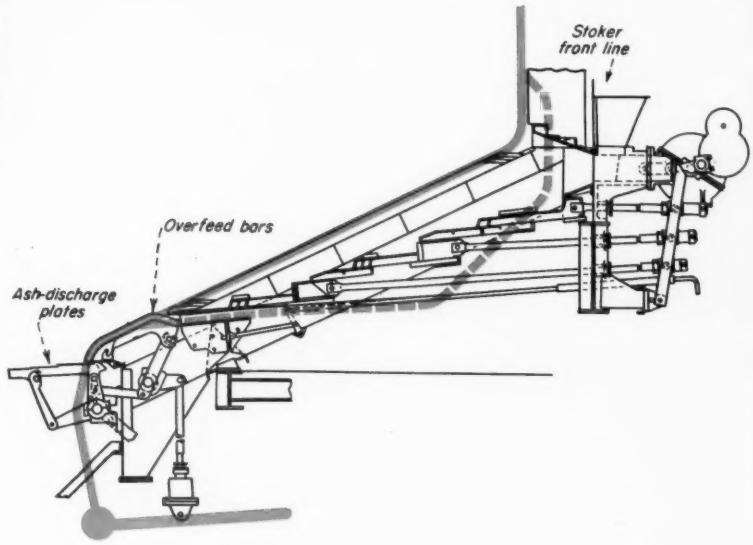
To approach continuous ash discharge while maintaining the relative simplicity of the dumping grates, a number of modifications are employed. The rocker dumping plate of Fig. 9 is hinged at one end and supported by a linkage. Hinged end moves with the extension grate, the action breaking up ash and clinker so part of refuse is continuously discharged.

Another design, Fig. 6, employs ash-discharge plates that move as a unit with the extension grate. These plates are counterweighted and together with a resistance to ash movement, maintain a seal between ash plates and rear



11 **Details of typical tuyere blocks show how the incoming air is distributed to the stoker fuel bed**

TUYERE DETAILS, WATERCOOLING



12 **Watercooling may be used to handle coals of low fusion temperature. Cooling tubes connect into main boiler circulation system**

wall. The hydraulic driving mechanism for these plates is timed by a solenoid-operated 4-way valve which sets the frequency with which ash-discharge plates recede. As they recede, resistance to ash movement is lowered. Once plates return to normal position they carry ash forward through the discharge opening. Removal of ash is continuous and plates do not dump.

In the stoker of Fig. 7, the position of the ash-discharge grate is adjusted according to load and ash-content of the coal so action of link-grate pushes ash through space between ash grate and watercooled bridgewall. Discharge is continuous.

Clinker-grinder rolls, Fig. 8, increase stoker length and require a deep ash pit to permit all combustible to burn out. But grinding helps to reduce carbon loss, tends to improve furnace conditions because of better air control and, where heavy ash quantities are to be handled, may prove a necessity.

Usually the front ashpit wall is ventilated for cooling and to help burn out combustible. Waterwalls with protective armor coating at the back of the pit assist in cooling and help to reduce maintenance. Where double rolls are employed they usually rotate outward, against adjustable breaker plates. To facilitate maintenance of wearing parts, rolls are usually built with renewable teeth. Clinker grinders are normally driven separately.

Tuyere Construction. As we have seen, the tuyeres constitute the principal source of air for the early stages of the combustion process. Secondary air may be admitted over the fire, usually through the front wall. In a number of installations, overfire jets, at relatively high pressures and velocities, have been found helpful as a means of producing turbulence and hence better mixing of air and volatiles.

Most units employ flat tuyere blocks, Fig. 11, grooved or vaned to split the air into a large number of small streams for good distribution through the fuel bed. A primary consideration in design is the problem of holding tuyere-block temperature down. Many use some form of extended surface to increase heat-dissipating area. Height of the individual tuyere blocks may be reduced to give a greater number of blocks per foot of stoker length and thus increase air-swept surface and decrease heat-absorbing surface. Still another stoker has tuyere blocks laid out vertically, with air moving around and out sides and top. Most units employ high sidewall tuyere-block construction. The air from this side source cuts down clinker adhesion in this area. In other cases, an armored watercooled section is installed along stoker sides.

Coal Characteristics. Multiple-retort underfeeds handle a range of bituminous coals. In many cases, run-of-mine coal is received and burned after crushing to a top size of about 2 in. Best results are usually found with caking coals having a relatively high ash-fusion temperature. Free-burning coals have a tendency to drift and avalanche. In general, the lower the fusion temperature, the more likely that clinker troubles will be met, although iron-oxide content of the ash exerts a marked influence on clinkering tendencies and furnace conditions, particularly temperature, can change the picture radically.

Perhaps the most important consideration in fuel selection is the caking characteristics of the coal. Different stoker designs impart varying degrees of agitation to the fuel bed and hence can handle coals of different caking qualities. There is, as yet, no clear-cut way of correlating caking qualities and stoker characteristics, hence the operator must learn by carefully noting the behavior of various coals on his particular unit.

Watercooling. Cooling tubes may be run under retorts and along the tuyeres, Fig. 12. They tie into the main boiler circulation system. This arrangement tends to increase radiant-heat absorption, lower fuel-bed temperature and chill ash to help prevent closing of air ports by slag. The over-all objective is to permit higher fuel-burning rates and to extend the range of coals that may be handled satisfactorily, particularly in regard to fusion temperature.

HOW FUEL PROPERTIES AFFECT STOKER-PLANT DESIGN AND OPERATION

SULPHUR

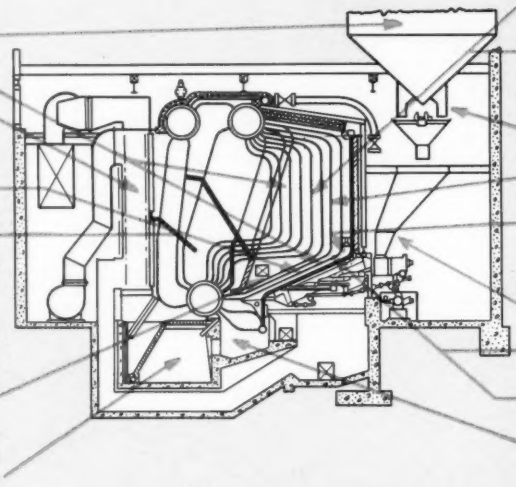
1 *If surface moisture is high, may cause corrosion of metal in bunkers, etc*
2 *May promote oxidation, heating in storage*
3 *Affects clinkering and slagging tendencies*
4 *Limits air-heater flue-gas exit temperature*

CAKING and COKING

1 *Stoker should agitate fuel bed in proportion to coal's caking tendency*
2 *Fuels forming weak coke masses are apt to be better for fluctuating loads*

ASH CONTENT and FUSION TEMPERATURE

1 *Presence of ash reduces handling and burning capacity; may increase handling cost*
2 *Amount of ash, fusion temperature and ash composition, in relation to burning rates, fuel-bed and furnace temperatures, indicate possibilities of clinkering and slagging*
3 *Equipment is needed for ash removal; disposal may involve cost. High ash content usually means high carbon loss to the ashpit*



VOLATILE MATTER

1 *Affects flame length and thus minimum setting height and furnace volume*
2 *Influences amount of overfire air needed and how it is applied*

MOISTURE

1 *Reduces fuel-handling and burning capacity; may cause handling difficulty (freezing, etc)*
2 *Must be evaporated in the furnace, causing "moisture loss"*
3 *Surface moisture may prove beneficial to fuel-bed structure (as in "tempering")*

SIZE

1 *Handling equipment should be designed to avoid size segregation*
2 *Size, along with caking qualities, affects the density and uniformity of the fuel bed*
3 *Fuel-bed density affects amount of draft needed and air distribution*
4 *Excessive fines may cause high carbon losses*

Selecting Fuel for

A fuel is a package of energy plus other qualities, good and bad, that affect the way it behaves in use and so influence the equipment needed to handle and burn it. Normally, the package can't be taken apart and we have to take it as it comes. This means shopping around for the one that offers the best all-round bargain. The way the bargain-hunting is done depends on the situation — if we're trying to find the best fuel for an existing plant we work differently from the way we do if we're looking over the situation for a plant still on the drafting boards.

For the existing plant, the problem is easy to visualize. We have certain equipment. It handles some kinds of fuel better than others. Thus we first find exactly what kinds of fuel it can do a satisfactory job with, and then decide which of these proves most economical. Where is the problem with the new plant?

Fuel Survey First. Designing a plant without first making a careful analysis of the fuel situation is like deciding to buy a railroad ticket without first deciding where you are going, but it's done all too often. A thoroughgoing fuel survey should precede everything but the decision to build the plant, since choice of fuel affects practically everything in the boiler house. What's more, each design decision made as details are worked out may prove a later limitation in buying fuel for the plant.

Purpose of a fuel survey is threefold: (1) to find out what fuels are available to the plant (2) to establish the relative value of these fuels, and (3) to attempt to predict, or at least allow for, changes in relative value in future years. It would be wrong to say this is a simple job, except where only a few fuels are available, but there is no part of the design that pays bigger dividends over the life of the plant. In many cases, it pays to bring in a fuel consultant to make the survey.

Sources of Data. Where gaseous and liquid fuels are available the survey tends to be relatively simple because differences in type and grade play little part with these fuels. Where coal is involved the story is likely to be different; here the job is often skimped, just where thoroughness pays the biggest dividends. In many areas, a wide range of kinds and sizes is available; how to get to know about them?

Much information about coal is available in publications of the Bureau of Mines and in directories such as the *Keystone Coal Buyer's Manual*. In recent years, coal producers in various areas have formed associations to disseminate information about the coals mined in these areas. Large individual producers offer similar fuel-engineering services. Independent fuel consultants keep up-to-date files on coal characteristics, availability and price trends.

From sources such as these it should be possible to set up a list of the fuels available to the proposed plant, complete with characteristics and costs. This should be arranged on a cost-per-delivered-Btu basis. If allowance didn't have to be made for differences in the properties of the fuels and, therefore, in the kind and amount of equipment necessary for burning and handling them, this list would give the answer. As it is, it's just a starter toward a more complete study that takes into consideration plant design and cost.

Preliminary Analysis. It is impracticable to make a complete study for each fuel involved, showing estimated operating costs (including labor and maintenance) and estimated investment. Luckily, this is rarely necessary. Usually it is possible to estimate operating costs for, let's say, oil and the most likely of the bituminous coals available, and then to prepare rough investment figures for each kind of plant.

If the results of this preliminary analysis come out closely enough to be affected by differences in operating cost or investment for various kinds of coal, the comparison can be made on a more accurate basis. As a practical matter, in such cases it might be wiser to decide on coal, since a later change to oil or gas would require only minor plant changes and modest investment. On the

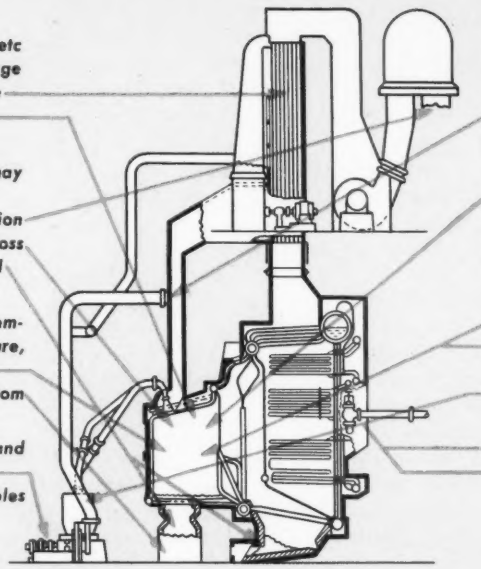
HOW FUEL PROPERTIES AFFECT PULVERIZED-COAL DESIGN AND OPERATION

SULPHUR
1 *May cause corrosion of metal in bunkers, etc*
2 *May promote oxidation, heating in storage*
3 *Limits air-heater flue-gas exit temperature*
4 *Affects slagging tendencies*

ASH CONTENT
1 *Reduces handling and burning capacity; may increase handling costs*
2 *More ash usually means more flyash emission*
3 *Retards combustion and increases carbon loss*
4 *Involves expense for removal and disposal*

ASH-FUSION TEMPERATURE
1 *Ash content, composition and fusion temperature, in relation to furnace temperature, indicate slagging possibilities*
2 *Influences choice of type of furnace bottom*

SIZE
1 *Pulverizer capacity slightly greater and grinding cost lower on smaller sizes*
2 *Fines may cause handling and dust troubles*



VOLATILE MATTER
1 *Burning low-volatile coals is improved by preheating primary and secondary air, by low primary air volume and high furnace temperature*
2 *Low-volatile fuels ignite less readily and require longer burning time. This affects furnace volume and, more particularly, location and amount of cooled surface*

MOISTURE
1 *Reduces handling and burning capacity; may increase handling difficulty and cost*
2 *Must be evaporated in furnace, causing a loss*
3 *Affects ignition; increases flame length. Preheating secondary air helps*
4 *High moisture means more drying in mill*

GRINDABILITY
1 *Major coal factor affecting mill capacity*
2 *Major factor affecting grinding cost (both power consumption and life of wearing parts)*

New Plants and Old

other hand, shifting an oil- or gas-fired plant to coal may prove expensive and even impossible unless suitable provision has been made for storage and handling. Combination firing often proves a practical solution where several fuels are competitive.

What's Ahead? At this stage, consideration should be given to possible future shifts in the fuel situation, for both price and supply. In general, coal prices tend to change fairly slowly. Large supplies, relatively consistent production costs and regulated freight rates all contribute to this stability. On the other hand, oil and gas prices tend to show more variation, with the local supply situation playing a greater part than with coal. A study of past performances of each fuel in the given area will shed some light on what may be expected. Where the outlook is doubtful, either for price or supply, it may pay to add slightly to the investment and provide for combination firing, or incorporate, in the design, space and layout features that make a future fuel shift possible and less expensive.

An interesting example of the effect of fuel-situation changes can be seen now on the West Coast. There, for many years, hydro power has been a major energy source and the relatively few steam plants have been fired by oil or gas. Continued load growth and lack of remaining good hydro sites, except on the far reaches of the Columbia River, mean heavy steam-plant construction during a period when demand on petroleum products is high. In view of doubts of the final outcome of this situation, far-sighted designers of new utility plants are providing space for coal-handling and pulverizing equipment, and dust collectors, in the event a shift to coal may be necessary later.

The important consideration in all this is that a power plant represents a long-term investment. It is only prudent to protect this investment against future changes as far as it is possible to foresee them.

Choice Between Coals. Assuming that the preliminary analysis shows some form of coal to be the best fuel, what happens next? This depends somewhat on the coals involved, and also on the kind of firing equipment contemplated. A few examples will show how.

Assume the plant in question is, for controlling reasons, to be stoker fired. If the comparison lies between free-burning and caking coals, nature of stoker selected depends on type of coal chosen. If, for example, the free-burning coal and an unagitated-bed stoker proves the best combination, such a choice more or less rules out caking coals from later consideration. Where the decision carries this limiting effect, it should be made with extreme care, and assurance as to continuance of the supply and price situation is necessary.

Fuel Flexibility. The other common situation can be illustrated by considering a large plant where pulverized-coal firing is contemplated. Here the choice is likely to be between setups varying largely in degree, rather than in type, as in the previous example. Specifically, such a case is likely to boil down to a comparison between a minimum-investment plant, which can handle only a limited range of coals, or a similar but more generously designed layout capable of handling a wide range. This latter layout will probably feature greater furnace volume for lower heat release, and more pulverizer capacity.

Keeping first cost down weighs heavily both with plant owners and the manufacturers who supply equipment for their plants. At such a time, possible future savings from cheaper fuels and from greater latitude in fuel buying, are likely to look small. More and more, experience indicates that this is shortsighted; sound practice requires that plant design be such as to permit handling the entire range of coals that may now be available or may come into the picture in the future.

Watch Design Details. Even after a wise choice of fuel and general plant layout is made, the question of fuel must be kept in the foreground at every

stage of the actual design. Fuel properties and plant design tie-in at many points, as diagrams on pages 110 and 111 show. Attention to this angle at the drafting-board stage keeps some small limitation from creeping into the plans. Such a restriction might look big when the time comes to operate the plant.

SPENDING THE FUEL DOLLAR

So much for fuel selection as a factor in plant design. Let's turn now to the problem of buying fuel for an existing plant—one that was, in all probability, designed without benefit of a fuel survey. "Needle-in-the-hay-stack" purchasing leads to high steam cost and operating headaches. Responsibility for proper selection rests squarely on the shoulders of the power engineer. He is the only man, aside from the independent fuel consultant, who understands all the facts needed to spend the fuel dollar wisely. The purchasing agent can help with his knowledge of market conditions and buying procedure, the salesman and fuel-service engineer can supply facts about their fuels, but the power engineer must coordinate these with plant requirements and make the choice.

Because coal is a complex substance, selection cannot be reduced to a simple formula. What follows is an outline of a sound procedure which can be followed in most plants. Because it involves a minimum of testing and a maximum of "horse-sense," it comes closest to meeting small-plant needs.

The right coal for any plant is the one that will carry the load, meet all reasonable operating requirements and produce lowest over-all steam cost. While any coal can be burned in any plant, after a fashion, every practical engineer knows that many plants have design and equipment limitations that bar certain coals, either because they will not carry the load, because reliability will be seriously impaired, or because intolerable operating difficulties will be encountered.

To eliminate a lot of unorganized trial-and-error testing, the power engineer must examine every part of his plant from coal pile to ashpit and stack, with but one thought in mind, to locate and evaluate every factor affecting coal selection. Even the engineer familiar with his plant will find such a fuel-engineering analysis reveals limitations he wasn't aware of or puts the finger on the exact cause for some limitation only vaguely recognized.

Of equal importance, he will find that some limitations thought to exist will disappear on close examination. By removing false restrictions on coal choice, the analysis may actually lead to savings from wider buying latitudes.

The check list on this page gives some idea of the questions the power engineer must ask and answer. Experience and records will furnish some of the answers definitely and easily; others will have to be determined by trial. For example, a low boiler setting causes smoke trouble at high burning rates with high-volatile coals. The engineer knows this but has no records that would indicate the maximum amount of volatile matter that will permit operation at high rates without exceeding the smoke requirements. A few tests with sample shipments of coal will give the answer.

Limiting factors on coal use will take various shapes in different plants; in many cases the limitation will occur outside the furnace. For example, inadequate ash-handling equipment may require putting a limit on the ash content of fuels burned. A plant equipped with considerable air-heater surface, which produces low exit-gas temperature, may find it necessary to limit sulphur content to avoid rapid and expensive corrosion.

In considering furnace and firing equipment, it will be found that each factor of the design must be considered in relation to burning rates encountered and nature of load; that is, whether it is steady or fluctuating. For example, minimum ash-fusion temperature for clinker-free operation on an underfeed stoker depends largely on combustion rate. Likewise, nature of load affects importance of caking qualities of coals; a fluctuating load may bar a strongly caking coal from use on a stoker with inadequate agitation of the fuel bed, or from a hand-fired grate.

The engineer must also remember that one property of a coal may modify another. Thus presence of excessive fines may aggravate clinkering tendencies, producing trouble with a coal having apparently satisfactory ash-fusion characteristics.

Finally, in making the fuel analysis of his plant, the engineer must distinguish between limitations and preferences. For example, in a plant with barely enough pulverizer capacity, if grindability drops below a definite point, the load can't be carried; coals with lower grindabilities are worthless. However, if pulverizer capacity is ample, the engineer may still prefer high-grindability coals since grinding costs will be somewhat less. Saving in power consumption and cost of replacing wearing parts will indicate how much can be paid for higher grindability.

TYPICAL QUESTIONS FOR PLANT FUEL SURVEY

FUEL AND ASH HANDLING

- Is coal stored long enough to make its weathering characteristics important?
- Need to watch heating tendencies?
- Would wet coal cause handling troubles?
- Would dust from excessive fines constitute a nuisance?
- Does rough handling bar friable coals?
- Do segregation difficulties put premium on close sizing?
- Does inadequate handling limit ash?
- What is coal- and ash-handling cost per ton, including labor?
- How much does ash disposal cost?

LOAD CONDITIONS

- What burning rate results from maximum load? What is duration of peak?
- What is lowest load to be carried for any length of time?
- Is load fluctuating or fairly steady?
- Is spare boiler capacity available?

SMOKE AND DUST EMISSION

- Is smoke restricted by law? How?
- Is there any specific restriction on fly-ash? If so, what?
- Does plant have effective dust collectors?

OPERATION

- To what extent is combustion controlled automatically?
- Are operators experienced, competent?
- Does plant have adequate metering and facilities for testing?

FURNACE

- Volume ample, heat release conservative?
- Is setting height adequate?
- Does lack of refractory surface make ignition difficult?
- What is furnace temperature just ahead of first tube row?
- What is temperature in combustion zone?
- Does furnace promote turbulence, mixing?
- How much air preheat, if any?

STOKER SYSTEMS

- How much agitation does fuel bed get?
- How well can underfire air be distributed and controlled?
- Is there enough overfire air, at the right places, with enough velocity?
- How much do coal size and caking qualities affect fuel-bed structure?
- What is limit on ash-fusion temperature to avoid clinkering troubles?

PULVERIZED-FUEL SYSTEMS

- Is mill capacity ample for low grindability coals?
- What is grinding cost per ton, including parts replacement?
- Does inadequate drying limit moisture?
- Does amount and location of watercooled surface restrict volatile content?
- Is furnace dry-bottom or slag-tap? What range of ash fusion can be handled?
- Does furnace bar high-ash fuels requiring long flame travel?

Some properties of coal have importance only as limits, never as preferences. For example, once the minimum ash-fusion temperature for trouble-free operation has been determined, any increase has no actual value.

The completed plant analysis boils down primarily to a set of limitations expressed as far as possible in coal properties that can be measured (ash content, fusion temperature, sulphur content, etc.) with properties that still defy exact expression (caking quality, weathering properties) stated as clearly as possible. Armed with this analysis, the power engineer can tackle the list of coals available, eliminating immediately those that fail to meet minimum requirements.

At this point relative prices enter the picture. The list of coals remaining after the first elimination should be set up on the basis of delivered-cost-per-Btu. This will immediately permit a second elimination, divided into two parts: (1) of the coals meeting all requirements, eliminate all but the best two or three from the delivered cost standpoint, and (2) from the coals exhibiting one or more undesirable qualities, eliminate those where low cost seems insufficient to compensate for undesirable properties.

Note that up to this point the only testing required has been of a simple sort and that even such trials as mentioned for setting the upper limit of volatility are only needed where plant records and observations are lacking on a particular point. Elimination can be carried even further without need for full-fledged evaporation tests. Each of the coals whose cost per Btu is low should be studied to determine how much weight must be given to the undesirable properties which pull its price down. High ash content may make no difference in a plant where ash can be sold; in a plant where removal must be paid for every increase in ash content involves a definite cash outlay. Thus, more coals may be eliminated.

For the small plant without test instruments, this may be enough. What looks like the best value among the remaining coals can be used for a short period. If it behaves satisfactorily and there is no apparent increase in operating troubles or maintenance it can be used with a fair degree of confidence.

If the plant has equipment for evaporation testing, plant trials will help verify the analysis up to this point and further sort out the remaining coals. By avoiding hit-or-miss plant testing, a large number of coals can be given consideration and the necessary careful testing can be given those worthy of it, all without excessive expense.

To be worthwhile, plant tests must be carefully made and the results must be analyzed properly. The errors involved in casual tests will often exceed the differences in coal quality. Every effort must be made to keep load conditions the same from test to test. Boiler surfaces should be equally clean. Finally, each coal should get equal attention and skill from the operating force. This does not mean each should be fired the same way; it means each should be fired to get best results, allowing for its peculiarities on the given equipment. This, in turn, means that each test should be preceded by a "warm-up" period to give the operating force a chance to get acquainted with the coal and its behavior. During this warm-up and the test itself, everything connected with the coal's performance should be studied and checked against the plant analysis.

LOWEST-COST COAL

If none of the coals display any markedly unsatisfactory operating characteristics, final selection will depend on over-all steam cost indicated for each. This will be made up of fuel cost, as calculated from the evaporation results, and maintenance and labor costs as estimated from observation.

Differences in evaporation results must be taken with a grain of salt since relative coal values are not the only factors affecting evaporation. Operation of other factors can often be determined and allowed for by calculating a boiler heat balance.

Unless plant testing extends over a fairly long period, it is difficult to estimate any differences in operating costs due to different coals. Items like increased power cost for handling or pulverizing can be measured but differences in maintenance costs will not show up for some time and then must be analyzed carefully to be sure they result from some property of the coal.

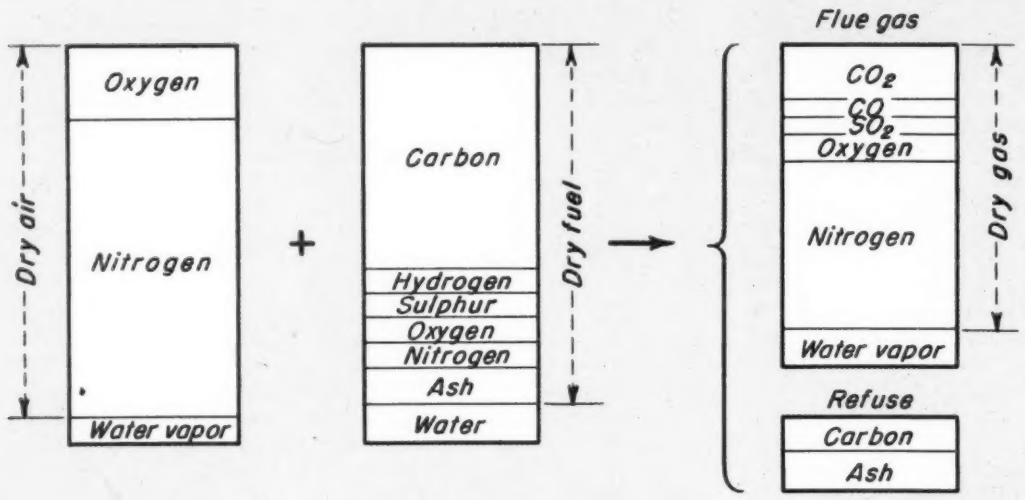
Normally analysis and testing will yield several coals having nearly the same value, any one of which will prove economical.

Once the job is done, the engineer must stay with it, for fuel values change and so do plant conditions. For example, improved preparation has raised ash-fusion temperature of West Kentucky coals enough to make them "available" to many midwestern plants formerly unable to use them. The vigilant engineer will keep his eyes open for such changes. He will also constantly revise his fuel specifications as changes in equipment and amount and nature of plant load so require.

ACKNOWLEDGMENTS

The editors wish to express their sincere appreciation to the many engineers who helped to insure the completeness and accuracy of this material by making technical data available and offering constructive comments. POWER is also indebted to the following manufacturers of firing equipment who furnished information used in preparation of this special section:

American Coal Burner Co
American Engineering Co
Babcock & Wilcox Co
W N Best Combustion Equip Co
Blaw-Knox Co, Power Piping Div
Wm Bros Boiler & Mfg Co
Brownell Co
Canton Stoker Corp
Combustion Engineering Co
Combustion Equipment Co
Coppus Engineering Corp
Denver Fire Clay Co
Detroit Stoker Co
C H Dutton Co
Eclipse Fuel Engrg Co
Engineer Co
Enterprise Engine & Fdry Co
Erie City Iron Works
Faber Engineering Co
Fairbanks, Morse & Co
Fisher Industrial Co
Flynn & Emrich Co
Foster Wheeler Corp
Hammel Oil Burner Co
Hammel Oil Burning Equip Co
Hoffman Combustion Engrg Co
Illinois Stoker Co
Iron Fireman Mfg Co
Johnston & Jennings Co
Kennedy-Van Saun Mfg & Engrg Corp
Laclede Stoker Co
James Leffel & Co
Lee B Mettler Co
National Airoil Burner Co
Peabody Engineering Corp
Petroleum Heat & Power Co
Preferred Utilities Mfg Co
Ray Oil Burner Co
Riley Stoker Corp
W S Rockwell Co
Schutte & Koerting Co
Simplex Oil Heating Corp
Staples & Pfeiffer
David Stout & Sons
Strong-Scott Mfg Co
Superior Combustion Industries
Surface Combustion Co
Timken Silent Automatic Div, Timken-Detroit Axle Co
Todd Shipyards Corp, Combustion Equipment Div
Webster Engineering Co
Westinghouse Electric Corp
C H Wheeler Mfg Co
Whiting Stoker Co
York-Shipley Inc, Industrial Div
John Zink Co



How to Figure

First part of this special section outlines the chemical and mechanical basis of combustion. By an understanding of the chemical changes between air supply and fuel, and the final flue-gas or combustion products, the plant engineer can tell whether he has made best use of his fuel and air. In other words, all chemical elements entering a fire must equal the elements leaving; hence, we can set up a chemical balance sheet as a basis for analysis.

The bar chart above shows in a very general way what substances are in both air and fuel before burning, and what substances appear in the combustion products. Heights of the bar-chart areas should not be regarded as proportional, but merely as indicating whether the amount of substance is relatively large or small.

Large amount of nitrogen in the air supply performs no useful duty in the burning process. It does not combine with any of the other elements and simply passes on to form the major bulk of the flue gas in the combustion products. Nitrogen moderates the fire temperature; if it were eliminated flame temperature would be much higher.

Oxygen, the only active element in air, combines with the so-called combustible elements of the fuel to produce heat. While pure oxygen would produce much higher temperatures, it proves more economical to use air, of which only 21% by volume is oxygen.

Air invariably contains a certain amount of humidity. This water vapor ordinarily does not perform any useful function. Its amount is very small and it passes on in the same form as part of the flue gas.

Most commercial fuels consist principally of carbon or some form of carbon associated with hydrogen. Hydrogen amounts vary according to the fuel, very small in anthracite coal, relatively large in natural gas. Sulphur, found in small amounts in most fuels, combines with oxygen releasing heat, but the product, sulphur dioxide, corrodes metals. Thus sulphur is considered an impurity. Carbon and hydrogen are the important burnable elements; all others play no part with the exception of the small amount of oxygen usually present in many fuels. Small amounts of nitrogen will also be found in fuels.

Ash quantities vary with the fuel nature, being large to small in coals, and very small to zero in oil and gas. Ash consists largely of minerals and in some coals may have a large proportion of iron.

Water in fuels tends to be higher for coals than for oil and gas. During burning this water evaporates and appears as steam in the combustion products.

Upon completing the burning process and giving up most of the heat generated the combustion products take two forms, flue gas and solid refuse. The carbon dioxide, CO_2, results from the complete combustion of carbon with oxygen from the air (and with the small amount in the fuel). In a properly controlled fire, carbon monoxide, CO, does not appear in the flue gas since it forms from incomplete burning of carbon. If it does appear, the amount is generally small.

Sulphur dioxide, SO_2, never proves to be large because the initial amount of sulphur in the fuel is slight. As the flue gas cools on its way to the stack, sulphur dioxide dissolved in water may be formed under certain conditions. It produces a corrosive acid.

If fires could be burned under perfect conditions no oxygen would appear in the flue gas. But more than the theoretical air need must be introduced to effect adequate mixing of oxygen with carbon and hydrogen, and thus insure complete burning of all combustible elements. When this mixing is done all the oxygen will not be used up.

Largest part of nitrogen in the flue gas comes from the air, a relatively minute portion was originally in the fuel combined with the other elements.

PROPERTIES OF COMBUSTION ELEMENTS

Element or Compound	Formula	Molecular weight	At 14.7 psia, 60F: Weight, lb per cu ft	At 14.7 psia, 60F: Volume, cu ft per lb	Nature: Gas or solid	Nature: Combustible	Heat value, Btu: Per pound	Heat value, Btu: Per cu ft at 14.7 psia, 60F	Heat value, Btu: Per mol
Carbon	C	12	—	—	S	C	14,540	—	174,500
Hydrogen	H_2	2.02	.0053	188	G	C	61,000	325	123,100
Sulphur	S	32	—	—	S	C	4,050	—	129,600
Carbon monoxide	CO	28	.0739	13.54	G	C	4,380	323	122,400
Methane	CH_4	16	.0423	23.69	G	C	24,000	1012	384,000
Acetylene	C_2H_2	26	.0686	14.58	G	C	21,500	1483	562,000
Ethylene	C_2H_4	28	.0739	13.54	G	C	22,200	1641	622,400
Ethane	C_2H_6	30	.0792	12.63	G	C	22,300	1762	668,300
Oxygen	O_2	32	.0844	11.84	G	—	—	—	—
Nitrogen	N_2	28	.0739	13.52	G	—	—	—	—
Air*	—	29	.0765	13.07	G	—	—	—	—
Carbon dioxide	CO_2	44	.1161	8.61	G	—	—	—	—
Water	H_2O	18	.0475	21.06	G	—	—	—	—

*By volume, air is 79 parts nitrogen and 21 parts oxygen. The "molecular weight" of 29 is merely the weighted average of the molecular weight of the constituents.

Combustion

Water vapor in the flue gas comes from (1) air humidity (2) water in fuel (3) burning of hydrogen.

Solid refuse may be in the form of flyash going up the stack or in heavier masses collecting in the boiler ash hopper and on heating surfaces. This refuse consists largely of ash originating in the fuel, but sometimes there is a small amount of carbon caused by poor burning conditions.

Not shown in the bar chart are hydrocarbons that may appear in the flue gas when proper mixing has not taken place in the furnace. These fuel elements are in the gaseous form and represent important efficiency losses.

COMBUSTION EQUATIONS

Because air and fuel elements always combine in exact proportions the results of proper combustion can be predicted. Comparing actual results with predicted, a measure of performance can be established. Table above gives chemical data on the elements from which calculations can be made.

First let's consider the burning of carbon to CO_2. The number of atoms before and after the reaction must balance, and hence weights of the elements entering the reaction must equal weight of the product. In the equations below, the first one is the chemical reaction, the second the respective atomic or molecular weights taken from the table above, and the third the proportioning of these molecular weights referring to 1 lb of carbon as the base:

$$C + O_2 = CO_2$$
$$12 + 32 = 44$$
$$1\text{ lb} + 2.67 = 3.67\text{ lb}$$

or it takes 2.67 lb of oxygen to burn one pound of carbon to produce 3.67 lb of CO_2. Carbon originally is a solid, oxygen a gas, and the product is a gas.

Incomplete burning of carbon to CO is figured by:

$$2C + O_2 = 2CO$$
$$24 + 32 = 56$$
$$1\text{ lb} + 1.33\text{ lb} = 2.33\text{ lb}$$

When burning hydrogen:

$$2H_2 + O_2 = 2H_2O$$
$$4 + 32 = 36$$
$$1\text{ lb} + 8\text{ lb} = 9\text{ lb}$$

Here the combustion product is in the form of vapor, which condenses when flue gas cools to near atmospheric temperature.

Sulphur burns to sulphur dioxide as follows:

$$S + O_2 = SO_2$$
$$32 + 32 = 64$$
$$1\text{ lb} + 1\text{ lb} = 2\text{ lb}$$

Gas fuels are primarily composed of hydrocarbons which, when burned completely, produce carbon dioxide and steam. Two of the more common hydrocarbon fuels are as follows:

Methane:

$$CH_4 + 2O_2 = CO_2 + 2H_2O$$
$$16 + 64 = 44 + 36$$
$$1\text{ lb} + 4\text{ lb} = 2.75\text{ lb} + 2.25\text{ lb}$$

Acetylene:

$$2C_2H_2 + 5O_2 = 4CO_2 + 2H_2O$$
$$52 + 160 = 176 + 36$$
$$1\text{ lb} + 3.08\text{ lb} = 3.39\text{ lb} + 0.69\text{ lb}$$

Equation Application. Above equations, with data on fuel analysis, form the basis of computing combustion performance. From the quantitative standpoint the most important factor is the air supplied. Ultimate analyses of fuels give the percentage of each element present. When figuring the amount of air needed to burn the fuel, the above equations can be used to find the oxygen. Since air contains 23.2% by weight of oxygen the pounds of air needed are the oxygen weight divided by 0.232. Letting *C*, *H*, *O* and *S* represent the pounds of element per lb of fuel, the weight of air theoretically needed is:

$$W = 11.5C + 34.5\left(H - \frac{O}{8}\right) + 4.32S$$

Combustion Products. Flue-gas analysis by orsat or similar apparatus is useful in checking on combustion efficiency. Knowing air components by volume to be 21% oxygen and 79% nitrogen, the following example shows how to figure back from the flue-gas components to find out how much air was initially supplied:

Flue-gas analysis (volume):

CO_2	8.86%
O_2	10.70%
CO	0%
N_2	80.44%
Total	100.0%

Assuming that there is zero nitrogen in the fuel, then all of this component must have come from the air. For every 100 cu ft of flue gas, the amount of air supplied = 80.44 ÷ 0.79 = 101.9 cu ft. In this air was (101.9 × 0.21 =) 21.4 cu ft of O_2 per 100 cu ft of flue gas. Actually, there are 10.7 cu ft of O_2 per 100 cu ft of gas left, which means 21.4 − 10.7 = 10.7 cu ft were used to burn the combustible elements of the fuel. The remainder was excess to insure complete combustion. On a percentage basis the excess air is (10.7 ÷ 10.7) 100 = 100%.

The amount of oxygen used to burn the fuel's carbon is: 8.86 (2.67 ÷ 3.67) = 6.44 cu ft per 100 cu ft of flue gas. The remaining oxygen, 10.7 − 6.44 = 4.26 cu ft per 100 cu ft of gas, was used to burn hydrogen in the fuel. Since most gas analyses are made at room temperature, the H_2O product of H_2 has condensed and therefore does not appear in the analysis.

HOW TO FIGURE BITUMINOUS-COAL COMBUSTION QUICKLY

1. Kind of fuel ..... Bituminous coal
2. Heating value as fired ..... 13,800 Btu per lb
3. Room temperature ..... 80 F
4. Flue-gas temperature ..... 520 F
5. Flue-gas analysis:
   a. CO_2 ..... 10.2%
   b. CO 0.6%
   c. O_2 ..... 9.2%
6. Boiler efficiency (from test) 74.4%

COMPUTATIONS:

7. Theoretical air, from scale 1 ..... 10.2 lb per lb fuel
8. Water produced by burning available hydrogen (scale 2) 0.35 lb per lb fuel
9. Total water from burning of coal = 0.35 + 0.05 = 0.40 lb per lb fuel
10. Actual air = 175% of theoretical = 1.75×10.2 = 17.9 lb per lb fuel
11. Total flue gas = air + coal − ashes = 17.9 + 1 − 0.2 = 18.7 lb per lb fuel
12. Dry flue gas = total flue gas − water produced = 18.7 − 0.40 = 18.3 lb per lb fuel
13. Sensible heat loss in dry gas = Dry gas weight × temperature rise × specific heat = 18.3 × (520—80) × 0.24 = 1930 Btu per lb fuel
14. Moisture heat loss per lb water = 1000 + ½ flue gas temperature = 1000 + 260 = 1260 Btu
15. Moisture heat loss = loss per lb water × lb water per lb coal = 1260 × 0.4 = 500 Btu per lb fuel
16. Incomplete-combustion loss, from chart 4 ..... 3.2%
17. Heat balance

	Btu per lb fuel	%
a. Dry-gas loss	1,930	14.0
b. Moisture loss	500	3.6
c. Incomplete-combustion loss	440	3.2
d. Unaccounted-for losses	660	4.8
e. Total losses	3,530	25.6
f. Useful heat	10,270	74.4
g. Heating value, Btu per lb fuel	13,800	100.0

18. Calculation of heat balance items:
    a. Dry-gas loss = 1930/13,800 = 14.0%
    b. Moisture loss = 500/13,800 = 3.6%
    c. Incomplete combustion loss = 13,800×0.032 = 440 Btu per lb fuel
    d. Unaccounted losses = 3530—440—500—1930 = 660 Btu per lb fuel
    e. Useful heat = 13,800×0.744 = 10,270 Btu per lb

Short-cut Combustion Calculations

Every textbook on steam power plants has a complete demonstration on the calculation of fuel combustion. Such an exhibit usually assumes that complete fuel, flue-gas and refuse analyses are available. But many plants, especially in the smaller capacities, do not have such complete information and cannot justify the money needed to determine it. Nevertheless, to operate economically these plants should closely follow their combustion performance because it is at this point that efficiency can be made or broken.

Assuming that such a plant has instruments for analyzing flue-gas composition and measuring flue-gas temperature the method described here suffices to tell the operator whether his combustion conditions are proceeding satisfactorily or not. While the method is approximate, numerous checks have shown the results to be within 2% of those found by using the longer, complete methods. The operator must know his fuel type and its heating value in Btu per pound *as fired*. The fuel supplier can normally give this information with satisfactory accuracy.

Scales and charts forming the basis of this computing method are given on the facing page. Their use is demonstrated in the table above for a given set of data using bituminous coal as the fuel. Let's follow through on this table, item by item, to find out how the calculations are made.

Items 1 to 6 are the data that must be known as mentioned above. The boiler efficiency should preferably be known by test, but a guaranteed efficiency using the same fuel will do if test results are not available.

Item 7. Scale 1 under the appropriate fuel classification on the facing page gives the theoretical air requirement when the fuel heating value is known. In this computation method, note that all weights are given in pounds per pound of fuel as fired.

Item 8. Water in the flue gas originates from three sources: (1) water originally in the coal (2) water produced by the burning of available hydrogen in the fuel (3) moisture in the air supplied for combustion. Of these we shall figure only (2), which is five to ten times as much as the amount appearing in (1). We do not attempt to figure the value of (3) because it is very small and its variation unimportant from the angle of everyday operation. *Item 8* is found by using Scale 2 for the appropriate fuel.

Item 9. Since original moisture in coal is unknown we assume it to be 0.05 lb per lb of fuel. Any error in this assumption will be of little practical importance in figuring moisture heat loss later, except with lignite, wood and very wet coals.

Item 10. First add CO_2 and ½CO to find 10.2 + ½(0.6) = 10.5. Use this value with Scale 3 for bituminous coal and read 75% excess air. On the lower scale it will be found that 9.0% O_2 corresponds to 75% excess air. This figure should be close to the O_2 value found by flue-gas analysis, which in this case was 9.2%. This is close enough to indicate a consistent gas analysis. If the CO_2 only should be known and the CO believed to be zero or negligible, enter Scale 3 with the CO_2 value to get the excess air magnitude.

Item 11. Practically speaking, everything fed to the furnace ultimately goes up the stack or into the ashpit. Then, to get the total weight of flue gas (per lb of coal fired) add 1 lb (of coal) to the air supplied and subtract the refuse produced per lb of coal. The refuse generally contains the original ash in the coal and perhaps some unburned carbon. Hence the amount of refuse is always greater or at least equal to the original ash weight in the coal, unless some ash is lost up the stack. Fortunately the refuse correction for the flue gas is not important. An error of 50% in the refuse allowance usually affects the total flue gas less than 1%. For practical purposes it is close enough (for any bituminous or anthracite coal) to assume 0.2 lb refuse *for this calculation.*

Item 12. Dry gas and water vapor in the flue gas must be separated to calculate the amount of heat energy carried off by each.

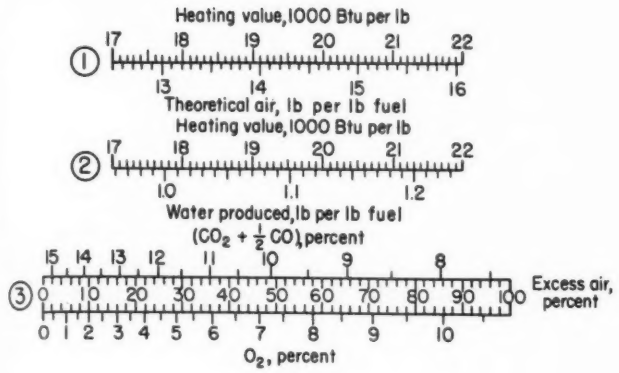
Item 13. Largest loss in boiler furnaces is the heat energy carried off by the dry gas. It is proportional to the amount of dry gas and the number of degrees above room temperature to which it is heated. These Btu loss figures are rounded off to the nearest 10 Btu. The method does not warrant closer figuring.

Item 14. Water in the coal as fired and the water produced by burning the fuel's available hydrogen must be heated to the boiling point, evaporated and then superheated to the flue-gas temperature. The formula given calculates the heat approximately needed to put 1 lb of water through these heating steps, starting with room temperature of 80 F. The formula is also suitable for room temperature ranging from 60 to 100 F.

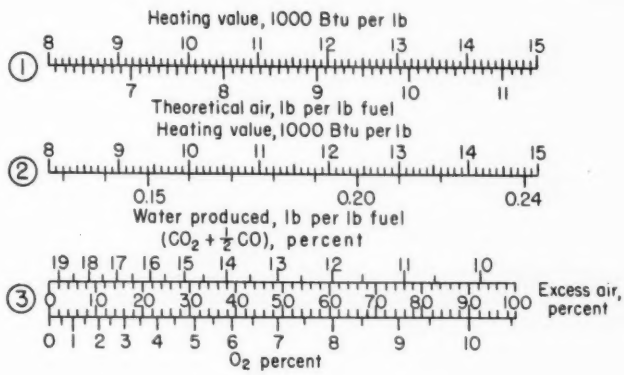
Item 15. The previous step calculated the heat energy per lb of water; this formula corrects this figure to heat

SCALES AND CHART FOR COMBUSTION PERFORMANCE ESTIMATE

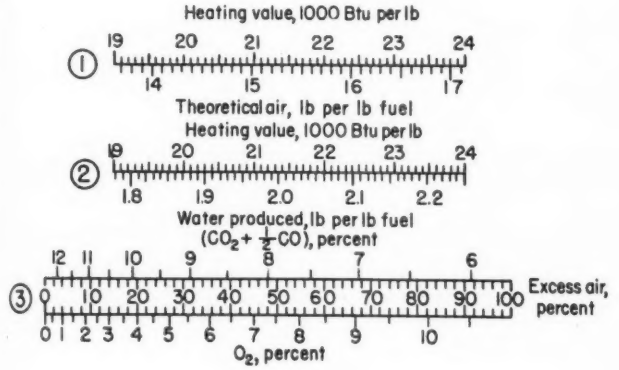
FUEL OIL


Heating value, 1000 Btu per lb
Theoretical air, lb per lb fuel
Heating value, 1000 Btu per lb
Water produced, lb per lb fuel
(CO2 + ½ CO), percent
Excess air, percent
O2, percent

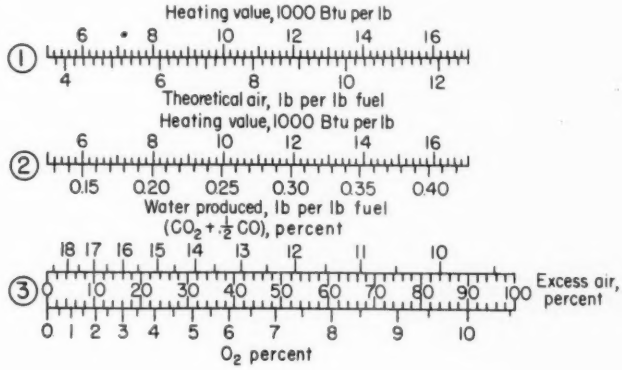
ANTHRACITE COAL

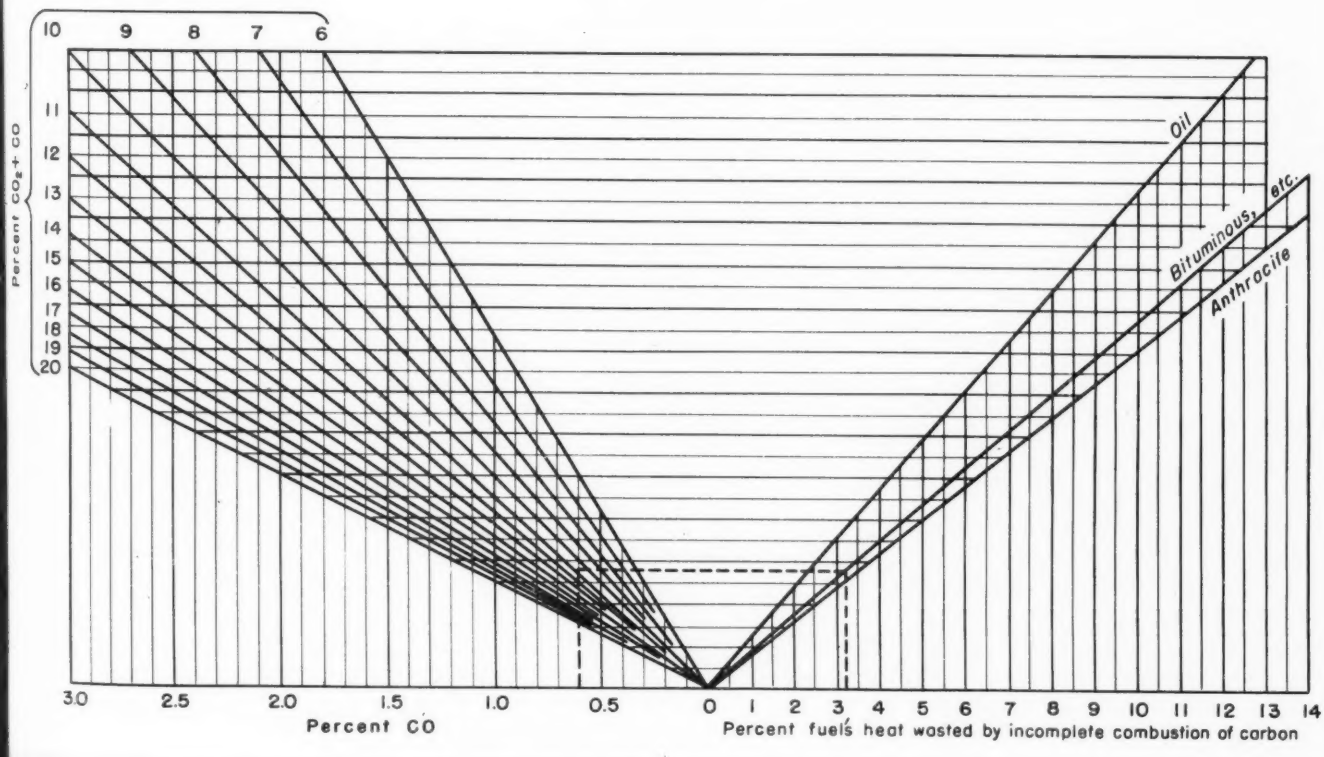

Heating value, 1000 Btu per lb
Theoretical air, lb per lb fuel
Heating value, 1000 Btu per lb
Water produced, lb per lb fuel
(CO2 + ½ CO), percent
Excess air, percent
O2 percent

NATURAL GAS


Heating value, 1000 Btu per lb
Theoretical air, lb per lb fuel
Heating value, 1000 Btu per lb
Water produced, lb per lb fuel
(CO2 + ½ CO), percent
Excess air, percent
O2, percent

ALL RANKS OF BITUMINOUS, LIGNITE, WOOD


Heating value, 1000 Btu per lb
Theoretical air, lb per lb fuel
Heating value, 1000 Btu per lb
Water produced, lb per lb fuel
(CO2 + ½ CO), percent
Excess air, percent
O2 percent



AIR REQUIRED FOR AND PRODUCTS OF COMBUSTION

Gives required combustion air and products for common combustibles burned with theoretical air requirements. Air and products are given in mols, cu ft and lb (see right-hand column) for 1 mol, 1 cu ft and 1 lb of fuel

Fuel	For 1 mol of fuel					For 1 cu ft of fuel					For 1 pound of fuel					
	Air		Other products (than N_2)			Air		Other products (than N_2)			Air		Other products (than N_2)			
	O_2	N_2	CO_2	H_2O	SO_2	O_2	N_2	CO_2	H_2O	SO_2	O_2	N_2	CO_2	H_2O	SO_2	
C	1.0	3.76	1.0	—	—	—	—	—	—	—	.0833	.313	.0833	—	—	Mols
	379	1425	379	—	—	—	—	—	—	—	31.6	118.8	31.6	—	—	Cu ft
	32.0	105	44.0	—	—	—	—	—	—	—	2.67	8.78	3.67	—	—	Pounds
H_2*	0.5	1.88	—	1.0	—	.00132	.00496	—	.00264	—	.250	.940	—	0.5	—	Mols
	189.5	712	—	—	—	0.5	1.88	—	—	—	94.8	356	—	—	—	Cu ft
	16.0	25.6	—	18	—	.0422	.139	—	.0475	—	8.0	26.3	—	9.0	—	Pounds
S	1.0	3.76	—	—	1.0	—	—	—	—	—	.0312	.1176	—	—	.0312	Mols
	379	1425	—	—	379	—	—	—	—	—	11.84	44.6	—	—	11.84	Cu ft
	32.0	105	—	—	64	—	—	—	—	—	1.0	3.29	—	—	2.0	Pounds
CO	0.5	1.88	1.0	—	—	.00132	.00496	.00264	—	—	.179	.0672	.0357	—	—	Mols
	189.5	712	379	—	—	0.5	1.88	1.0	—	—	6.77	25.4	13.53	—	—	Cu ft
	16.0	52.6	44.0	—	—	.0422	.139	.116	—	—	.571	1.88	1.57	—	—	Pounds
CH_4	2.0	7.52	1.0	2.0	—	.00528	.0198	.00264	.00528	—	.125	.470	.0625	.125	—	Mols
	758	2850	379	—	—	2.0	7.52	1.0	—	—	47.4	178	23.7	—	—	Cu ft
	64.0	210	44.0	36.0	—	.169	.556	.116	.0950	—	4.0	13.17	2.75	2.25	—	Pounds
C_2H_2	2.5	9.40	2.0	1.0	—	.0066	.0248	.00528	.00264	—	.0962	.362	.0769	.0385	—	Mols
	947	3560	758	—	—	2.5	9.40	2.0	—	—	36.4	137	29.15	—	—	Cu ft
	80.0	263	88.0	18.0	—	.211	.694	.232	.0475	—	3.08	10.13	3.38	.692	—	Pounds
C_2H_4	3.0	11.29	2.0	2.0	—	.00792	.0298	.00528	.00528	—	.1071	.403	.0714	.0714	—	Mols
	1137	4280	758	—	—	3.0	11.29	2.0	—	—	40.6	153	27.1	—	—	Cu ft
	96.0	316	88.0	36.0	—	.253	.834	.232	.0950	—	3.43	11.29	3.14	1.286	—	Pounds
C_2H_6	3.5	13.17	2.0	3.0	—	.00923	.0347	.00528	.0079	—	.1167	.439	.0667	.10	—	Mols
	1326	4990	758	—	—	3.5	13.17	2.0	—	—	44.2	166.3	25.3	—	—	Cu ft
	112.0	369	88.0	54.0	—	.296	.972	.232	.1425	—	3.73	12.29	2.93	1.8	—	Pounds

*Varying assumptions for molecular weight introduce a slight inconsistency in the values of air and combustion products from the burning of hydrogen. True molecular weight of hydrogen is 2.02, but the approximate value of 2 is used in figuring the air and combustion products.

energy per lb of fuel to be consistent.

Item 16. Loss due to incomplete combustion of the carbon to CO is found directly from the chart at the bottom of page 117. Enter chart with 0.6% CO and move vertically up to slanting line equaling sum of CO_2 and CO, which is 10.8%. From this intersection move horizontally to right to line marked *Bituminous,* then down to lower right-hand scale showing percent of fuel's heating value wasted.

Item 17. By setting up the table shown with lines *a* to *g* all the foregoing calculations may be summarized by entering them in the proper spaces as shown in color. The calculations needed to fill the rest of the table are given in *Item 18* in correspondingly lettered lines.

The unaccounted losses as shown in *Item 18, line d,* are found by difference and here include chiefly: (1) loss of carbon to ashpit (2) radiation from boiler and furnace (3) cumulative error (plus or minus) of all data and computations. Any marked variation in this quantity should be cause for an operator to look for trouble in his steam generator unless he can account for it directly by known factors.

Carbon loss in refuse to the ashpit is usually figured from analyses of the coal and the refuse. The foregoing method assumes that no analyses are available. If the coal-ash content is known, the carbon loss can be calculated from measurements of coal fired and refuse produced. To illustrate let's assume the following data:

Ash in coal as fired, 7.4%; refuse produced per lb of coal, 0.096 lb. Then the refuse from each pound of coal fired must contain 0.096-0.074=0.022 lb of combustible material. Since this material will be pretty well "cooked" or heated to drive off the volatile gases, we can figure it as pure carbon with a heating value of 14,600 Btu per lb. Then carbon loss=0.022×14,600=320 Btu per lb fuel fired.

This method cannot be used where substantial amounts of carbon are lost up the stack, as in certain cases of pulverized fuel and stokers operating with heavy forced draft. Where carbon loss is figured it should, of course, be inserted in the heat balance, reducing the unaccounted losses by that amount.

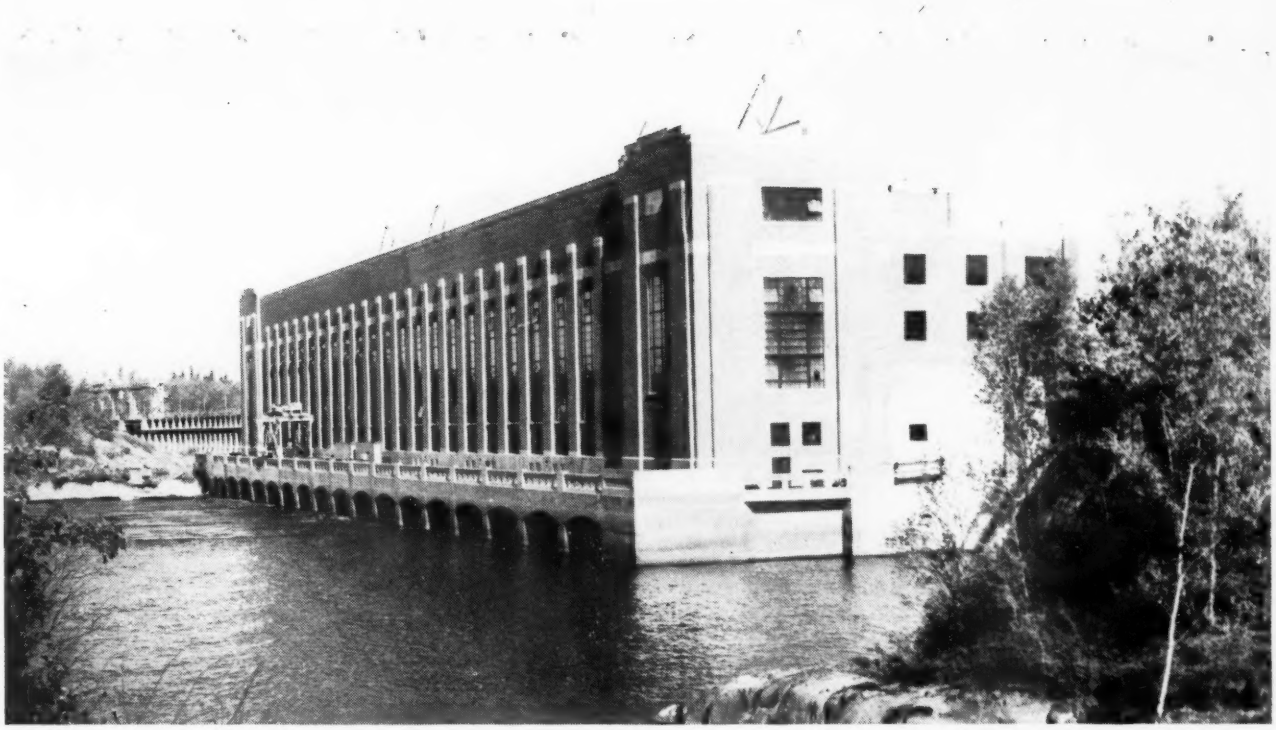
As-fired vs Dry. The heating value and analysis of fuel as fired varies with the amount of moisture associated with it. The moisture, in turn, constantly changes in amount during mining, shipping and storing. Hence, chemists and coal men sometimes prefer to quote the analysis of dry coal and give the moisture separately.

But all the foregoing computation and charts in this section are based on fuel as fired. If coal data are given on the dry basis they must be converted to the as-fired basis. For instance, let's assume that coal on the dry basis has 12,700 Btu per lb and 12.4% ash. If the as-fired coal has a moisture content of 4.5%, the conversion constant is 1.00−0.045=0.955. Then multiply the dry-basis figure by 0.955 to get the as-fired figure, or 12,700×0.955=12,130 Btu per lb as-fired coal.

This shortcut method was designed for the engineer who wants his answer quickly though his technical resources are limited. Combustion technicians in large power plants and others who make elaborate boiler tests and studies have all the paraphernalia for a complete analysis based on chemical relations. This method is not intended for their use.

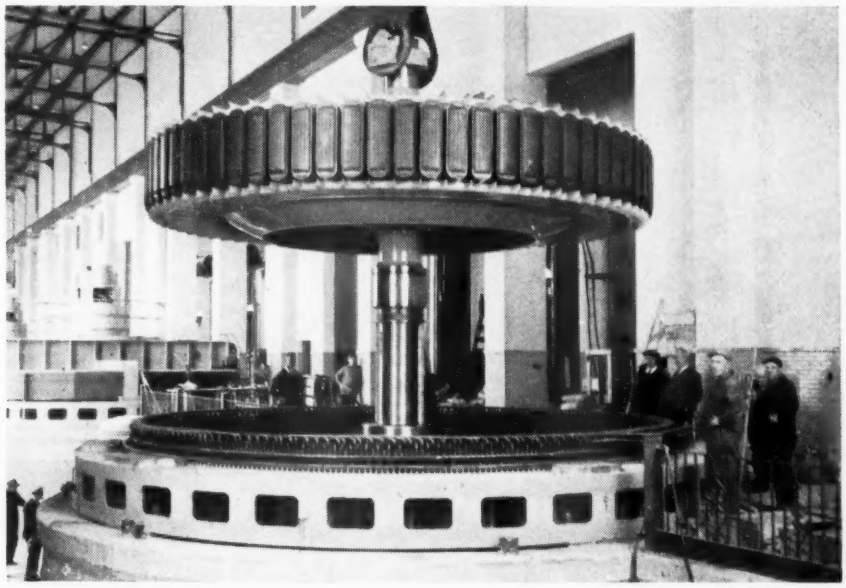
Calculation Data. Above table is compiled for the engineer who must deal with many fuels and their combustion. It gives basic data on relation between elements in the combustion process on (1) the mol basis (2) the volumetric basis and (3) the weight basis. Study of the table will show that it enables the rapid conversion of any calculation from one base to any of the two other bases with a minimum of both time and error.

Each of the three groups of columns refers to one of the calculating bases. For example, the first group of columns refers to the mol basis, that is, one mol of the fuel element shown in the first column. The first line in each box gives the corresponding mols of oxygen and nitrogen in air needed for burning this element or the number of mols of combustion products resulting from the completed reaction.



SLAVE FALLS PLANT and seven dams stretch for nearly 3000 ft across the Winnipeg River. This Canadian plant requires 32,000 cfs of water during the full-load operation of eight 12,000-hp fixed-blade propeller-type vertical-shaft turbines

Slave Falls Plant Is Completed



ASSEMBLING GENERATOR. Rotor being lowered into stator of eighth and last generator. Because of its slow speed, 94.7 rpm, rotor has large diameter and 72 poles

▶ The city of Winnipeg, Manitoba operates two hydro plants on the Winnipeg River—Pointe du Bois of 104,400 hp, and Slave Falls of 96,000 hp. The latter, completed recently, has eight 12,000-hp 94.7-rpm vertical-shaft units, operating under 30-ft head. This makes Slave Falls one of the great low-head plants in Canada, requiring 32,000-cfs discharge at full load. Each turbine has a fixed-blade propeller runner connected to a 10,000-kw 6600-v 60-cycle generator. Generator-rotor diameters are large because of slow speeds. Each has 72 poles excited by 250-v dc.

Seven Dams. There are seven dams, as follows: a rock-filled one 550 ft long and 80 ft high; a sluiceway dam 446 ft long; two spillways, 503 and 330 ft long; an ice sluice 113 ft long connecting with a nonoverflow dam 110 ft long; a core-wall dam 330 ft long. Dams and power house have a total length of about 3000 ft. With the islands, they span the river. The power house, 583 ft long by 111 ft wide, is built between the spillway and the ice sluice.

Power from this plant and Pointe du Bois is transmitted over four 132,000-v lines 86 miles to Winnipeg, where there is a pulverized-coal-fired central-steam-heating and standby power plant on the system. The steam plant has 27,000-kw boiler capacity that converts excess hydro-generated power into heating steam at very low cost.

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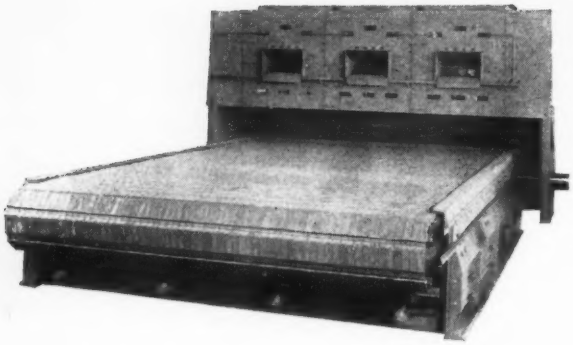

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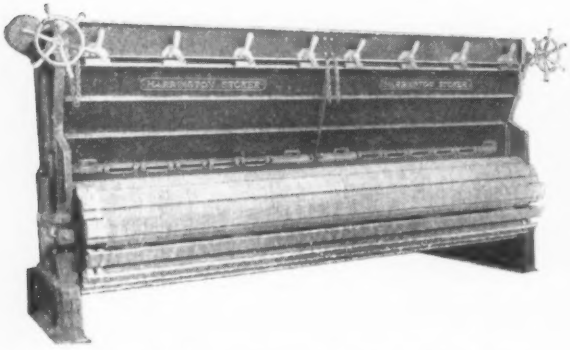

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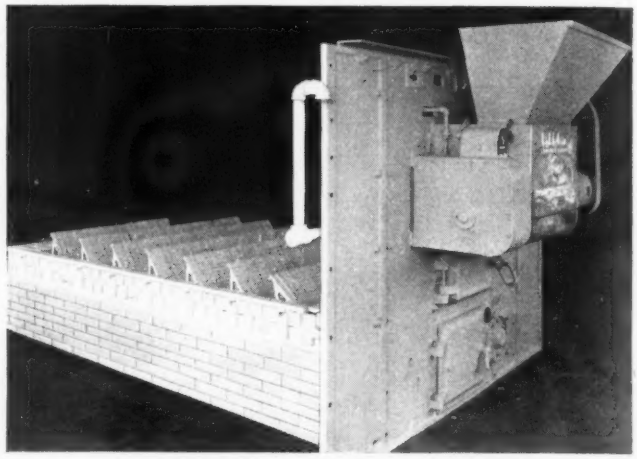
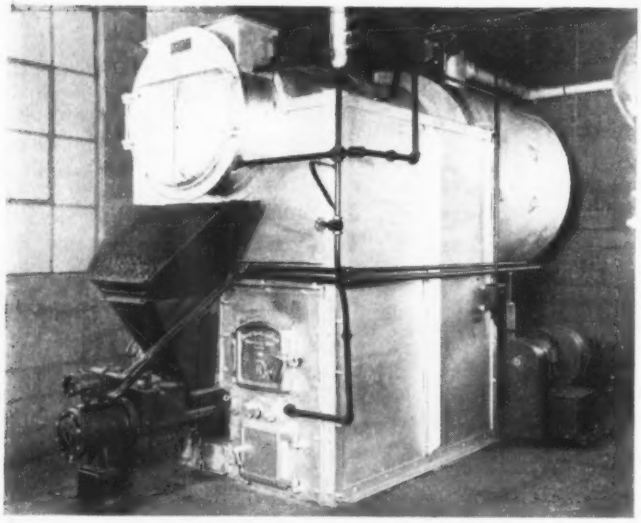
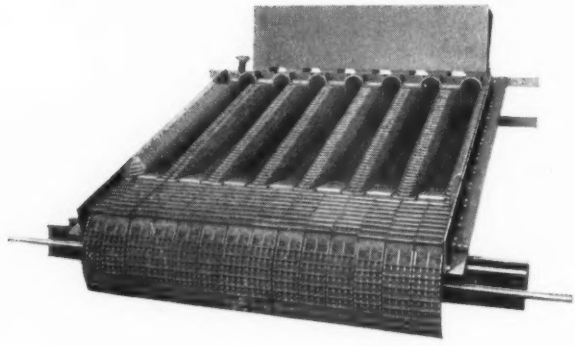


Riley Dumping Grate Spreader Stoker



Riley Side-dump Underfeed Stoker



Riley Multiple Retort Underfeed Stoker

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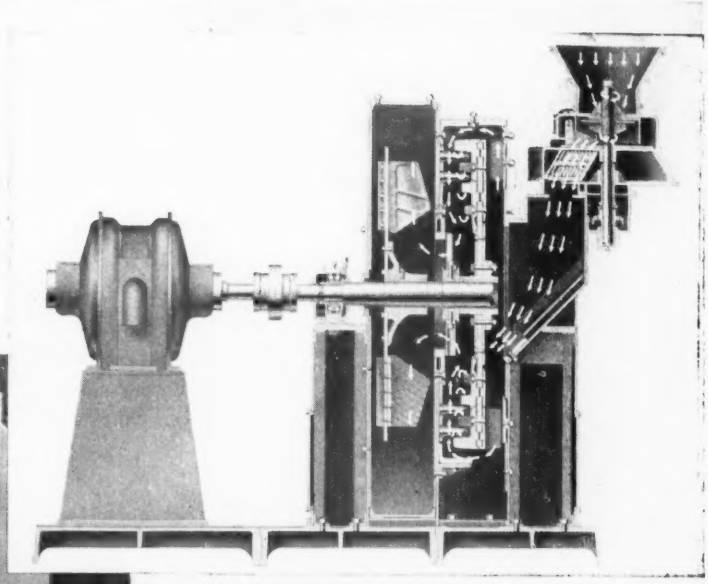
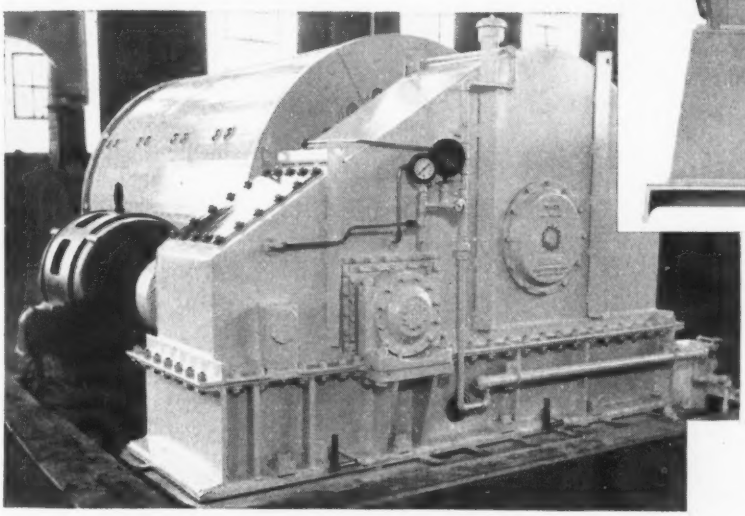
Riley manufactures not only the Riley Atrita Unit Pulverizer, which has been installed in so many of the country's leading power plants, but also the new Riley Ball Tube Mill, so that Riley can now offer you two distinctive types of coal pulverizers. Riley also manufactures pulverized coal burners and combination coal, oil and gas burners.



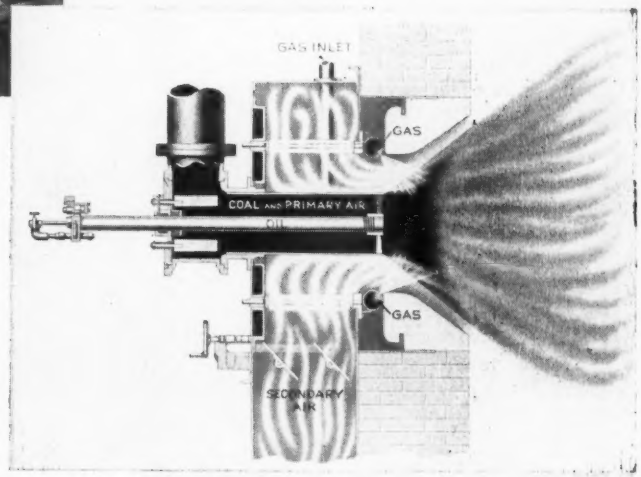
Riley Atrita Unit Pulverizer



Riley Ball Tube Mill

Complete Steam-generating Units

In addition to its complete line of coal-burning equipment Riley also manufactures complete steam-generating equipment, including boilers, superheaters, water-cooled furnaces, air heaters, economizers and steel-clad insulated setting.



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A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

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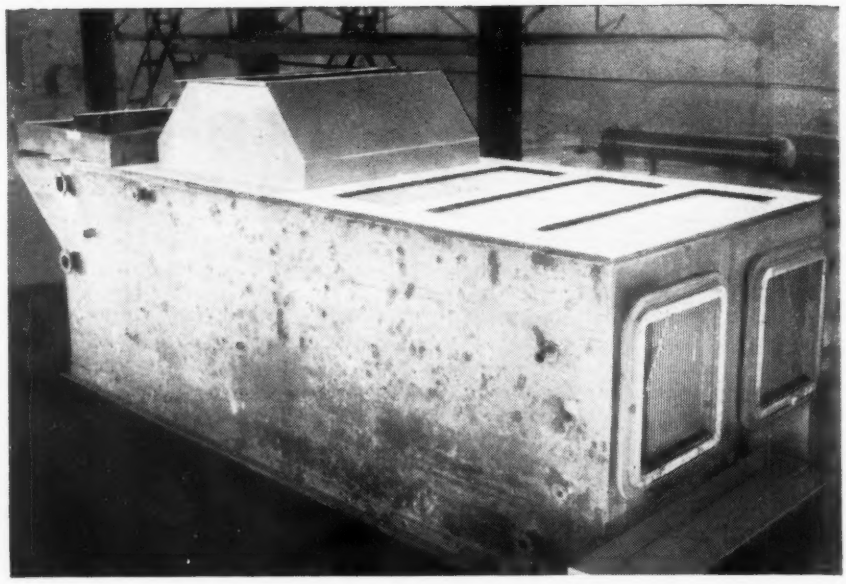
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

A Condenser That Travels On Trailers



CONDENSER, 14 ft wide by 32 ft long, waits in the Foster Wheeler, Carteret, N. J. Plant for transportation to the Rockland Light & Power Co, Tomkins Cove, N. Y.

► DURING THE WAR a number of destroyer-escort vessels were built with the condenser shell designed to act as support for the turbine-generator unit. Some few small stationary installations also followed this arrangement. And now the Rockland Light & Power Co, Burns and Roe, Inc, consulting engineers, is putting in a 20,000-kw unit to be supported in this manner at its new Tomkins Cove, N. Y. plant.

Manufacturing Problems. The manufacturing problems for such a piece of equipment—14 ft wide by 32 ft long, weighing 72 tons and containing 18,650 sq ft of ⅞-in. tubes, 32 ft long—made it necessary for Foster Wheeler Corp to put into effect several very special operations at their Carteret, N. J. plant.

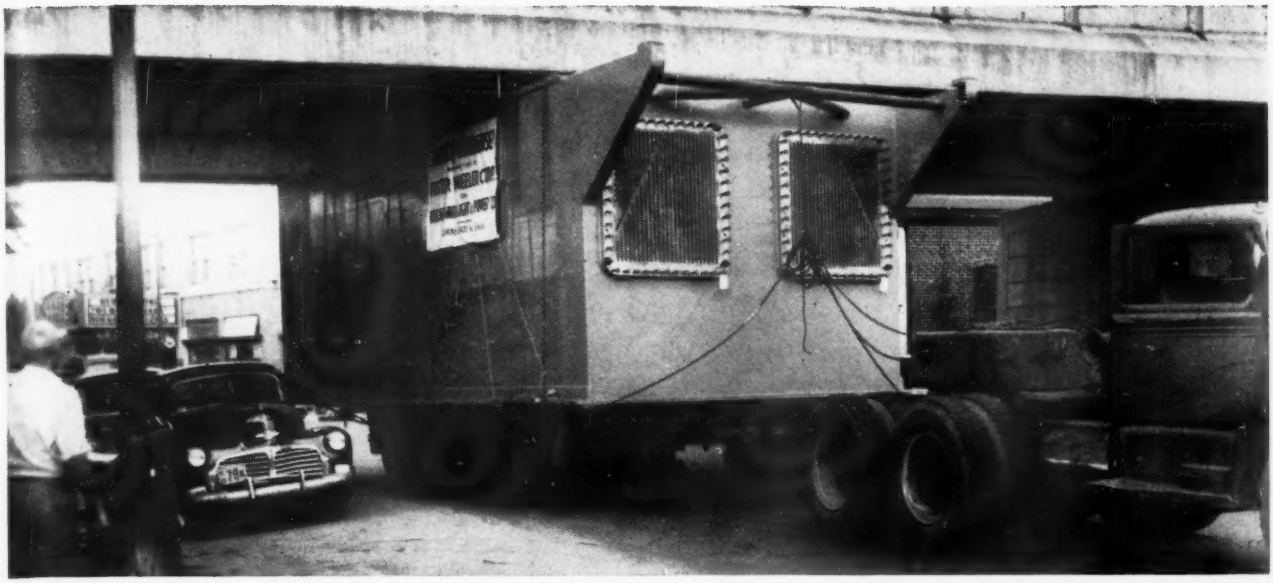
In addition to the condenser itself, upper picture, p 121, a heavy frame had to be built. This frame fits on the condenser and acts as a cradle on which the turbine rests, bottom picture, p 121. Its construction had to be of heavy steel. Both of these pieces were completed at the Carteret plant.

Transportation. Once completed the problem of transportation had to be solved. The very size of the pieces, 14 by 32 ft, ruled out the railroads, and the weight, 72 tons for the condenser, would have been too much for the unloading facilities at Tomkins Cove, N. Y., if it had been shipped by water. So trailer trucks were selected.

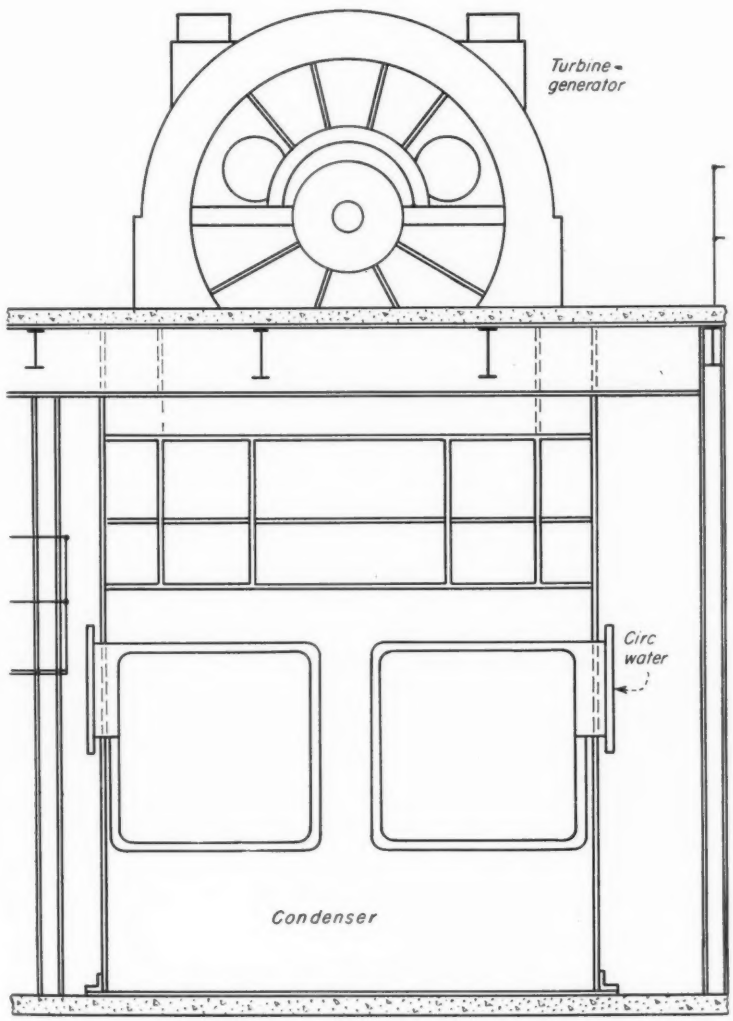
This meant a special trailer for the 72-ton condenser so constructed that 70% by weight was borne by it and the remaining 30% by the forward truck. The trailer has 16 wheels, four at each corner, with tires under a 100-psi air pressure. The forward truck, of conventional design, has eight wheels. A steel bar connects both trailer and forward truck. The forward truck has another bar connecting it to a tractor truck. The turbine frame employed a similar trailer and forward truck arrangement but required no special weight-bearing equipment.

HEAVY FRAME, a separate piece, fits upon condenser above and acts as cradle in which turbine assembly, p 121, rests. Condenser shell supports the entire weight

The job of loading the condenser on the trucks turned out to be a delicate one. The condenser had to be lifted in an exactly horizontal position so the loading on the truck sections was taken up evenly by all elements at the same time. In fact, considerable calculation



MOVING the completely constructed 72-ton condenser as well as the cradle frame required two trailer trucks. Here's the condenser just squeezing under a railroad bridge that crosses the approximately 45-mile route from plant to power station



FULLY ASSEMBLED 20,000-kw turbine and condenser, which is the largest to date where the condenser shell carries all the weight, looks like this when in position

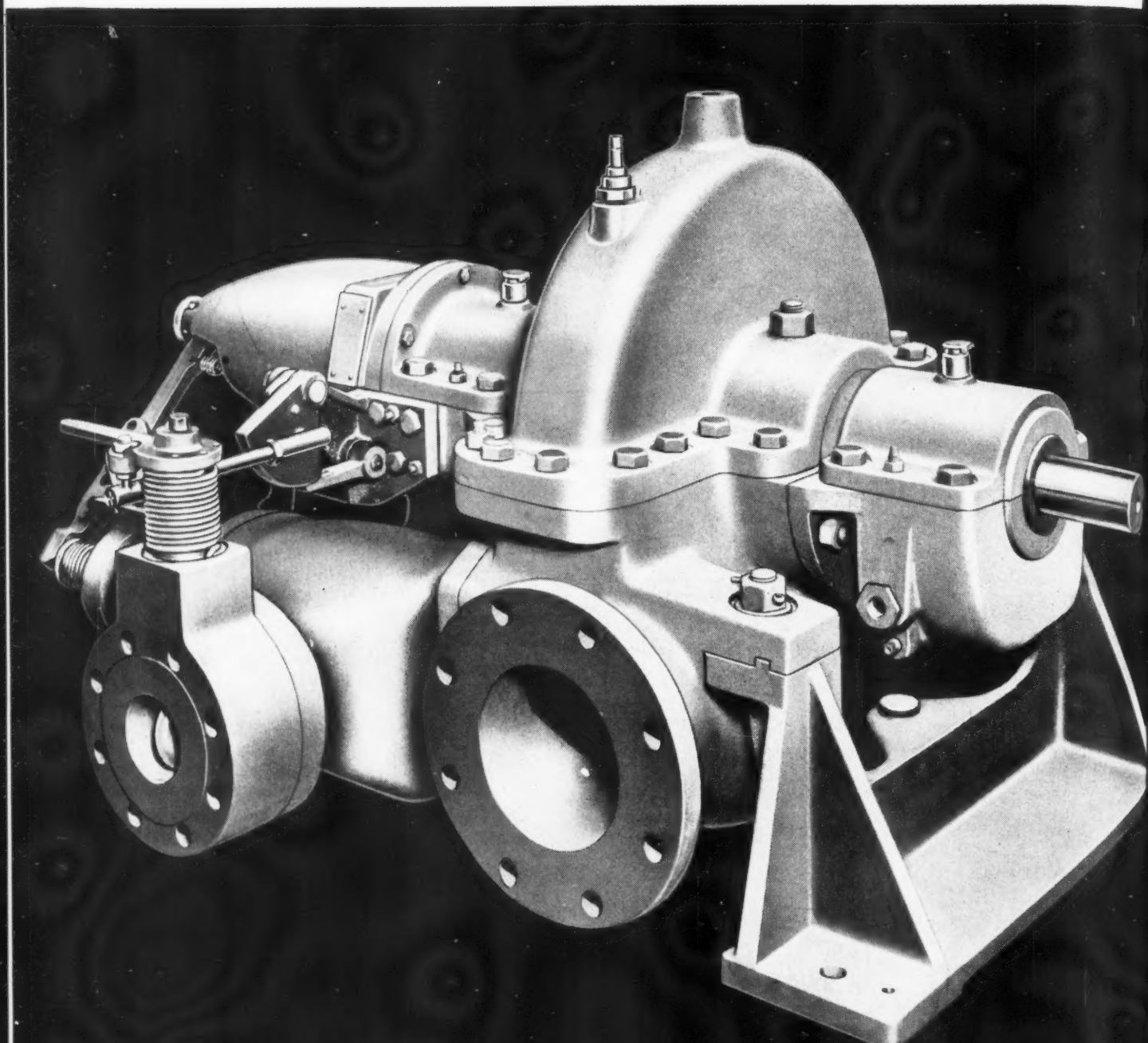
had to be made as to the individual bearing points so the originally designed 70-30 weight percentage divided as planned between trailer and forward trucks.

After loading, the condenser had to be secured in position to prevent any chance of load-shifting when under way. Accordingly, welders went under the load and welded steel bars in place to hold the position of the load. In effect a special trailer-truck body had been made.

Special clearance had to be obtained from the highway departments of New Jersey and New York. They laid out a route over specifically selected highways and had to reinforce three bridges en route to carry the extra weight. In addition to these precautions, studs were removed from the top of the casing to give a greater clearance, under one bridge (see figure top of page) and avoid catching branches or electric-light wires.

Unlooked-for Delays. Still there were unlooked-for delays that developed. The hauling trip took place during some of the hottest days of the summer. Traffic lights, telephone wires and other lines, suspended across the highways, sagged. The truck caravan had to stop while these were lifted. And to top it all the heat plus the weight of the load forced one highway department to hold up the whole trip for a full day within five miles of the final destination because the roads were softening so much road damage might have been lasting.

For RUGGEDNESS, RELIABILITY



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Paper Machines, Jordans, Beaters, Coal Pulverizers and Line Shafts

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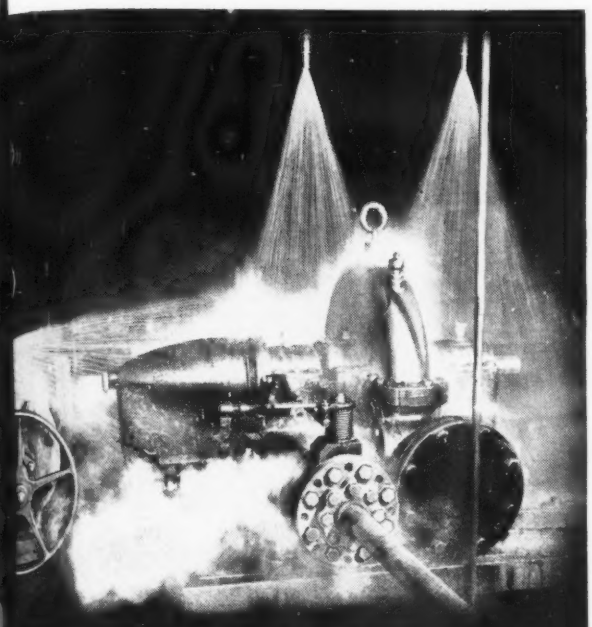
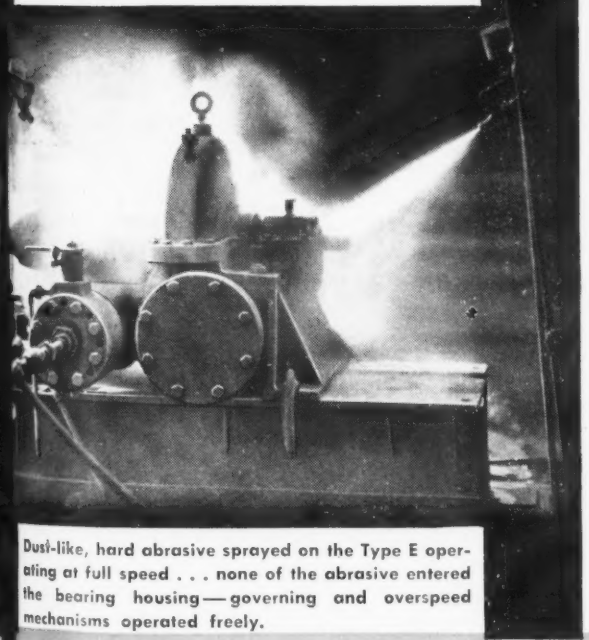


Water-test periods running for hours and hours—with turbine *operating* and *standing still*—prove the effectiveness of Type E bearing seals against water contamination of lubricating oil.



Dust-like, hard abrasive sprayed on the Type E operating at full speed . . . none of the abrasive entered the bearing housing—governing and overspeed mechanisms operated freely.

Type E turbines can "take it" under the most adverse conditions . . . in wet or dry locations, outdoors in any kind of weather, in subbasements . . . or anywhere that "the going is tough!"

Superior features which make the Type E *outstanding* are weatherproof bearing seals, corrosion-resisting gland zones, centerline support, dual-protection against overspeed, floating movement of governing and trip linkages, and parts interchangeability. These features minimize maintenance time and cost where Type E turbines are applied. Such features also assure dependable performance in continuous or "stand-by" operation.

Here's how ruggedness, reliability and economy are represented in Type E *turbines!*

RUGGEDNESS . . . The strong and sturdy appearance of the Type E exterior is characteristic of *all* parts that must withstand severe service for years.

RELIABILITY . . . Very special care, skill and experience are employed in the design and construction of Type E turbines to assure outstanding performance for long periods of continuous operation . . . or *instant* service when required as a "stand-by" unit.

ECONOMY . . . The Type E is carefully designed to provide for *maximum conversion* of heat energy into horsepower. For most economical selection, a variety of wheel sizes is available. This is particularly advantageous in plants where a number of turbines are required for different locations, and it is desirable to standardize on a single make. Interchangeability of parts between wheel sizes furthers this advantage.

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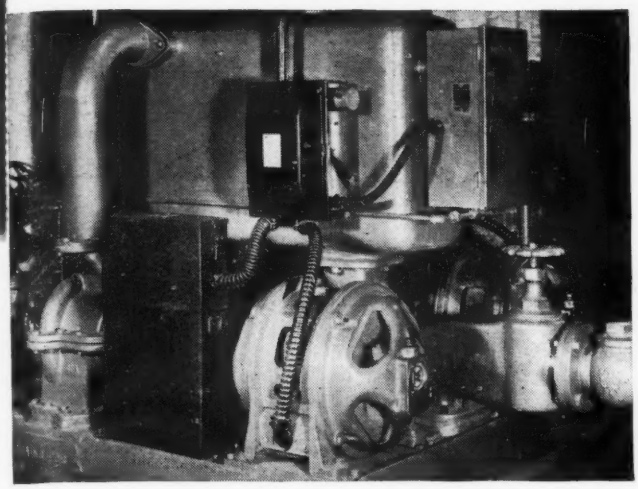
Growing Demand Expands Barbadoes

▶ As PART of its plant-expansion program to meet growing demands, the Philadelphia Electric Co is adding two units in an extension of its existing Barbadoes Station. Present plant, housing two turbines and four boilers developing a total of 45,000 kw, operates with 300-psig 600-F steam. Standing on the Schuylkill River it is about 15 miles northwest of Philadelphia.

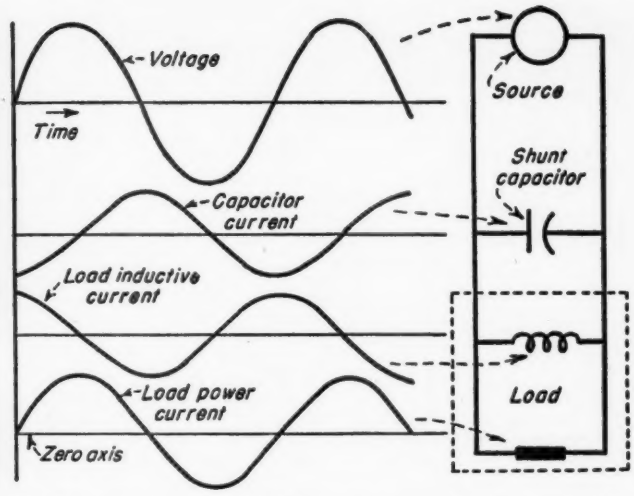
The two new preferred-standard 60,000-kw Westinghouse turbine-generators will each be supplied 850-psig 900-F steam by a single 600,000 lb-per-hr dry-bottom Foster Wheeler steam generator. No steam or feedwater connections between units or existing stations will be provided. First new unit is scheduled to go into service in Feb 1949 and the second during June 1949.

Fuel will be pulverized bituminous, at times mixed with a small percentage of anthracite. Oil can be burned during emergency conditions. Fuel is delivered by rail, and a large storage yard provided for coal.

Superheat control will be effected by partly condensing saturated steam entering superheater. Boiler and turbine controls and instruments for each unit will be placed on a common board near the unit boiler, but since the station also serves as a distributing center, the generator switching and loading will be controlled from a separate room. All five bleed points will be used to feed five closed heaters, deaeration taking place in condenser hotwell. Dravo Corp, constructors of the extension for the Philadelphia Electric Co, supplied the above photo.



1 Shunt capacitor energized with motor when the line switch is closed. Keep capacitor size less than 25% of motor kva



2 Picture a steady interchange of current between capacitor and inductive load. Source supplies only true load power

Capacitors Improve Pf and Cut Costs

Shunt capacitors are used in industrial plants to improve power factor, voltage and to cut cost of metered energy. Here's how they do it, also tips on use for best economy

By J S WILLIAMS
Central Station Engineer
Westinghouse Electric Corp

▶ MOST INDUSTRIAL PLANTS operate at a power factor less than unity. One practical method of improving lagging pf is the use of a shunt capacitor. When so used it supplies the magnetizing component of current, which is inherent in all inductive equipment. As a result feeders, transformers and generating equipment carry only the true power consumed by the load.

Shunt Capacitor Function. Effect produced by capacitors connected in shunt is demonstrated in Fig. 2. Sine functions of voltage and current are shown in a simple distribution circuit. A motor load connected in the system draws a power component of current I_p that is at all times proportional to the voltage and in phase with it. The motor, however, contains iron that must be magnetized. This is represented in the circuit by a parallel inductive branch. When line voltage is applied to the inductive branch, the resulting current I_m lags behind the applied voltage because of the electrical inertia of the inductive part of the load.

If a capacitive element whose rating is equal to that of the inductive branch is connected in parallel with the other two elements, the instantaneous current through the capacitive branch is always exactly equal and opposite to the inductive current. Inductance and capacitance, therefore, store and exchange energy in a way that requires no reactive current flow in the external circuit. The only current supplied by the generator in this example is the power-producing component, which no one has yet been able to cancel out.

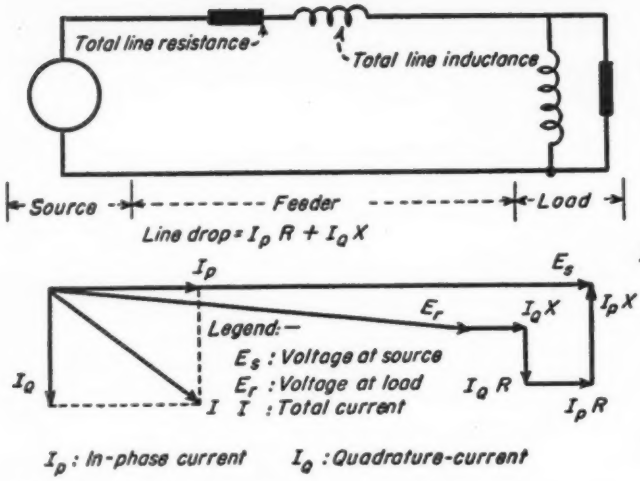
Another basic effect produced by connecting shunt capacitors to a normal distribution circuit is an increase in voltage along the supply lines. Higher potential results at load points because of interaction between line reactance and shunt capacitance. These two circuit elements, considered apart from other impedances and loads, produce a voltage across the capacitor that is higher than the voltage supplied to the distribution line. Increased load voltage tends to develop because a remote approach to series resonance occurs between line reactance and shunt capacitance. This voltage rise is normally offset by the voltage drop associated with the power component of current I_p. At light load the voltage rise may become excessive, resulting in need for switching capacitors in response to load cycles. Fig. 3 and 4 illustrate one way to analyze voltage rise produced by shunt capacitors.

Application of shunt capacitors produces interrelated benefits, hence following list may overlap in some respects:

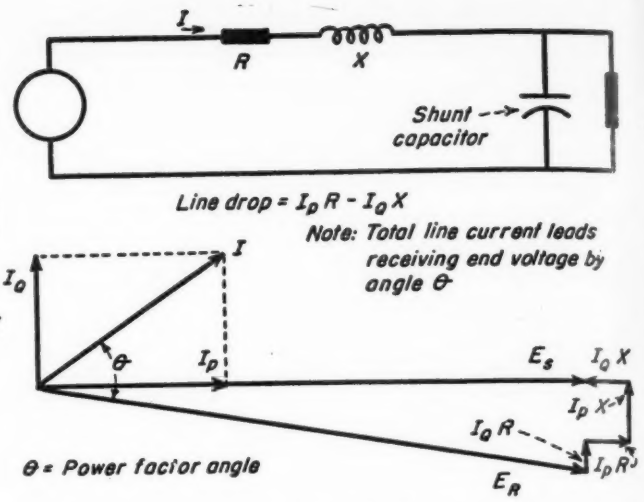
1. Load pf is improved.
2. Current carried by supply circuits and equipment is reduced or, conversely, more power-producing current can be transmitted over an existing circuit.
3. System losses are reduced.
4. Voltage drop in supply circuits is reduced.
5. Cost of metered electrical energy is reduced.

Selecting Proper Capacitor. Calculation of capacitor sizes is dependent on whether the unit is to be installed for correction of electrical characteristics of the power circuits or for reducing the monthly power bill. Usually it is not difficult to fit a capacitor installation to an existing or proposed load, to obtain either specified pf or desired voltage increase. A straightforward electric-circuit solution provides required capacitor bank rating.

A more detailed study is usually necessary to establish the right size of a capacitor bank when the application is primarily to reduce the power bill. Steps of kvar (kilovolt-ampere-reactive) demand in the rate schedule must be compared carefully with existing demands before the most effective correc-



3 Vector analysis of voltage drops in inductive circuit without shunt capacitors. Note value of E_r with respect to E_s



4 Capacitor boosts E_r greater than E_s and shifts pf to leading. The quadrature current is always 90 deg out of phase

tion can be determined. A careful analysis of consumption rates throughout a typical week or month is required to establish the minimum size of capacitor bank that is most effective in reducing kvar demand. Kvar-demand metering may not give credit to the industrial customer for leading pf, since this condition would normally exist only during off-peak conditions and is, therefore, of no benefit to the power company. It follows that the only effective portion of the available capacitor kvar is the amount required at any moment to balance the inductive kvar demand within plant.

To analyze cost relations in a proposed industrial-plant capacitor installation, following information is required on energy and equipment costs:

1. Rate schedule of electric utility company or generating costs of industrial power plant. Rate should include all details of energy and demand charges, pf clauses and special rates.

2. Load requirements of industrial plant including representative kva and associated pf during a definite interval. A typical period for such readings is one week.

3. Distribution circuit losses within plant that are affected by capacitor installation and their value under various plant loading conditions.

4. Fixed charges on equipment and installation costs for total selected, converted to same period chosen for energy and loss evaluation. These costs probably cannot be rated at a fixed amount per kvar because as more capacitors are considered, more elaborate switching equipment will be used.

Using above information, the advantage offered by a particular number of capacitors appears as the difference between total energy cost reduction and charges for new equipment. By determining this difference throughout a range of installed capacitive kvar, the most effective type of installation can be selected.

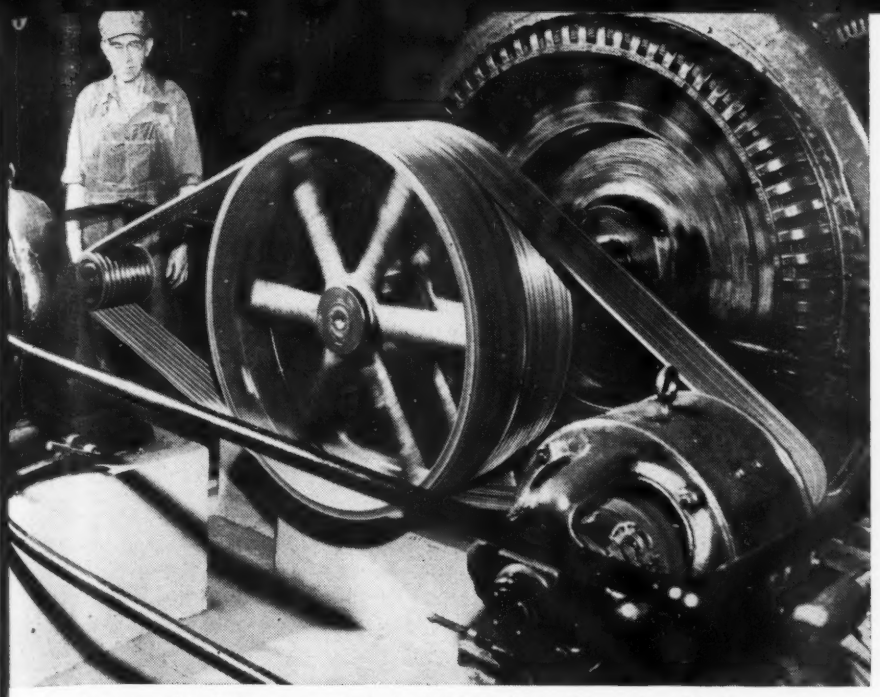
Switching Capacitors. Automatic or manual switching may be needed to meet supply or load conditions that are continually changing. An unswitched shunt capacitor can increase circuit voltage but its effect on regulation is negligible. A switched capacitor, however, can be arranged both to increase voltage and decrease regulation. The usual quantity to initiate switching on capacitor banks is voltage, but any other quantity that can be measured in the circuit is a likely candidate for this control job. Type of control selected depends on the prime objective in an installation.

A capacitor bank is conveniently switched in steps because it requires a minimum amount of extra equipment. Size of steps generally depends on the maximum change in voltage permitted at critical points on the system. Contactors or breakers in a switched bank must be selected with proper regard for the momentary currents and the interrupting duty imposed by a large concentration of capacitance. Equipment suitable for this type of duty is available and no difficulties result if it is properly selected and applied.

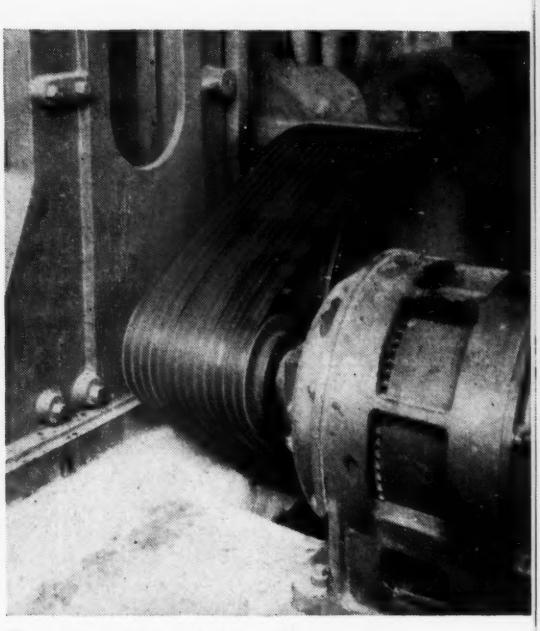
The kvar drawn by a capacitor varies according to the square of the voltage applied. This fact becomes useful where smooth control of capacitance is required. The plan is to use a regulator or tap-changing transformer to connect the capacitors to a particular point on the system where correction should be applied. The added complication and losses introduced by the regulator or transformer must be charged against the capacitor bank when this plan is contemplated.

Objectives of automatic switching may sometimes be more easily attained by manual switching of capacitors directly with the load, or by switching that is interlocked with the load. Fig. 1 shows a 3-phase enclosed capacitor installed beside a pump motor. A limitation on switching capacitors directly with induction motor loads has developed, making it necessary to limit capacitor size applied with a motor to a value usually less than 25% of motor kva. If this limit is not respected the motor-capacitor combination, when disconnected from the supply circuit with the motor still rotating, may build up over voltage by self-excitation in the local circuit formed in the motor reactance and connected capacitance. The setting of motor over-current devices should be rechecked after capacitors are connected directly at the motor terminals to correct for the reduction in line current.

A workable combination for many industrial plants is to install a permissible and reasonable amount of capacitance along with individual loads, and install the required remainder as a partially switched capacitor bank at some convenient location on the distribution system. This plan results in the installation of maximum corrective kvar, with minimum auxiliary switching equipment.



1 An example of the most economical V-belt drive. We replaced belts on these exciters after 17 years of 11-hour-a-day service without breaks or replacements



2 Well-engineered drives have a short center distance and large sheaves

How to Select the Most Economical V-Belt Drive

When costs are high, as they are now, it's not enough to provide a V-belt drive that is adequate for a job. For maximum service on a given investment, here's how to select one, says Frank H Rumble, Texrope drive dept, Allis-Chalmers Mfg Co

▶ FOR ABOUT 25 YEARS, every industry has applied multiple V-belt drives to power transmission within their field of applications. Here we will analyze the principles in good V-belt engineering and determine what constitutes the most economical drive.

Mechanics of engineering a V-belt drive are now well standardized, so an adequate drive for any application is usually obtained by following instructions in the catalog of any reputable V-belt or sheave manufacturer. While methods vary, all are based on the same fundamental principles of belt ratings, speed ratios, motor horsepower, load factors and the characteristics of the driven machine.

Theoretically, the most economical V-belt drive for any application is one that gives the most efficient service over the longest period. To provide the most efficient drive, the designer considers sizes of belts and sheaves, arc of contact, belt speed, overload capacity, characteristics of driven machine, and conditions under which the drive operates. This procedure insures that the drive is adequate to handle the job, with sheave diameters large enough to assure long belt life.

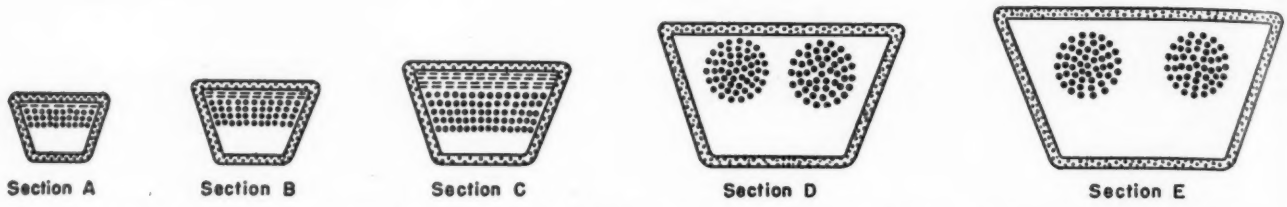
TABLE I—MINIMUM V-BELT SHEAVE PITCH DIAMETERS

Belt section	*Minimum pitch diameter*
A	3.6
B	5.4
C	9.0
D	13.0
E	21.6

The V-belt drive that is best from an engineering standpoint is almost always lowest in first cost as well as in maintenance. Let us consider the points to keep in mind when selecting the most economical drive. Our findings are based on standard V-belts and sheaves in general use and available at present.

Belt Size. Minimum sheave diameters have a definite relationship to the width and thickness of the belts used on the drive. Standard rubber V-belts are constructed of fabric, cord and rubber in what the manufacturers feel is the proper proportion to stand up longest under the work they are designed to do. Bending a V-belt in a natural, easy arc determines the smallest sheave that can be used without distorting the belt. If it is bent beyond this "easy arc" by using it on a too-small-diameter sheave, its superstructure is disarranged and internal friction heats it. This soon causes so-called *ply separation* and deterioration.

Using larger-diameter sheaves re-



3 Actual size of the five most popular V-belt cross sections A, B, C, D and E. These sizes were determined after many tests and have been found satisfactory in service. Minimum sheave diameters for these belts are given in Table I, p 125

duces internal friction and heat. For the five popular belt sizes, A, B, C, D and E, minimum sheave diameters can be recommended. Table I gives these sizes, determined after many tests and found satisfactory in service.

Laboratory tests and practical experience show reasonable belt life can be expected with sheaves as small as the recommended minimum. If possible, it is even better to use sheaves somewhat larger than the minimum. Using a 9.0-in. or 8.6-in. sheave with a C section belt, for instance, is not the difference between success or failure of the drive. But a 10.6-in. instead of an 8.6-in. sheave does make a great difference in the belt's life. If belts on an 8.6-in. sheave have a 2-year life, it is not unusual with a 10.6-in. sheave for the same drive to have a belt life of 4 years or more.

So consider replacement costs when installing a V-belt drive. Larger-diameter sheaves may cost more, but life is longer and belts are not replaced nearly so often. Cost of replacing one set of belts usually offsets the difference in cost of the slightly larger sheaves. To under-design a drive that is used any length of time is poor economy.

Belt Speed. Maximum diameter of sheaves used on a drive is governed by (1) space limits and (2) belt speed. The first condition requires little explanation. If space does not permit as large a diameter sheave as desired, the only thing to do is to use a smaller one with grooves for enough belts to drive the load safely. Belt speed requires a more detailed explanation. Between practical limits, the larger the diameter of the driving sheave, the greater the belt speed and the more horsepower each belt on the drive transmits. For greatest efficiency, belts must travel neither too fast nor too slow. What are these practical limits that govern selection of proper speed? Horsepower rating tables in V-belt manufacturers' catalogs show a recommended speed of 1000 to 5000 ft per min, depending on the diameter of the driving sheave.

There is a reason for these limits on speed. A belt at slow speed transmits less horsepower than one traveling faster. So the drive as a whole requires more belts when speed is low. Since the power rating of a belt drops off rapidly at speeds below 1000 ft per min, it is not economical to go below this point on most drives.

An equally good reason exists for limiting top belt speed. As speed approaches and exceeds 5000 ft per min, centrifugal force tends to stretch belts and throw them away from the groove. Thus, the effective arc of contact on the sheaves is reduced. Another consideration in speed is safety. Most cast-iron sheaves are constructed to withstand safely a rim speed not in excess of 5000 ft per min. While special drives are sometimes constructed for use at lower or higher speeds, it is best to observe the recommended limits for the average drive.

Arc of Contact. Arc of contact on sheaves must be considered when selecting an adequate drive. Horsepower ratings for different-sized V-belts are based on a 180-deg arc of contact. This arc depends on the difference in sheave diameters and the distance between shaft centers. If one sheave is smaller than the other, it has less than 180-deg arc of contact. The smaller the arc of contact, the greater the number of belts required for a given drive.

Base V-belt-drive selection on the prime-mover and load characteristics as well as on required horsepower and belt speed. Do not select size and number of belts for a drive on the basis of the prime mover's nameplate horsepower alone. Considerably more power is often needed to start a load than to drive it at normal speed.

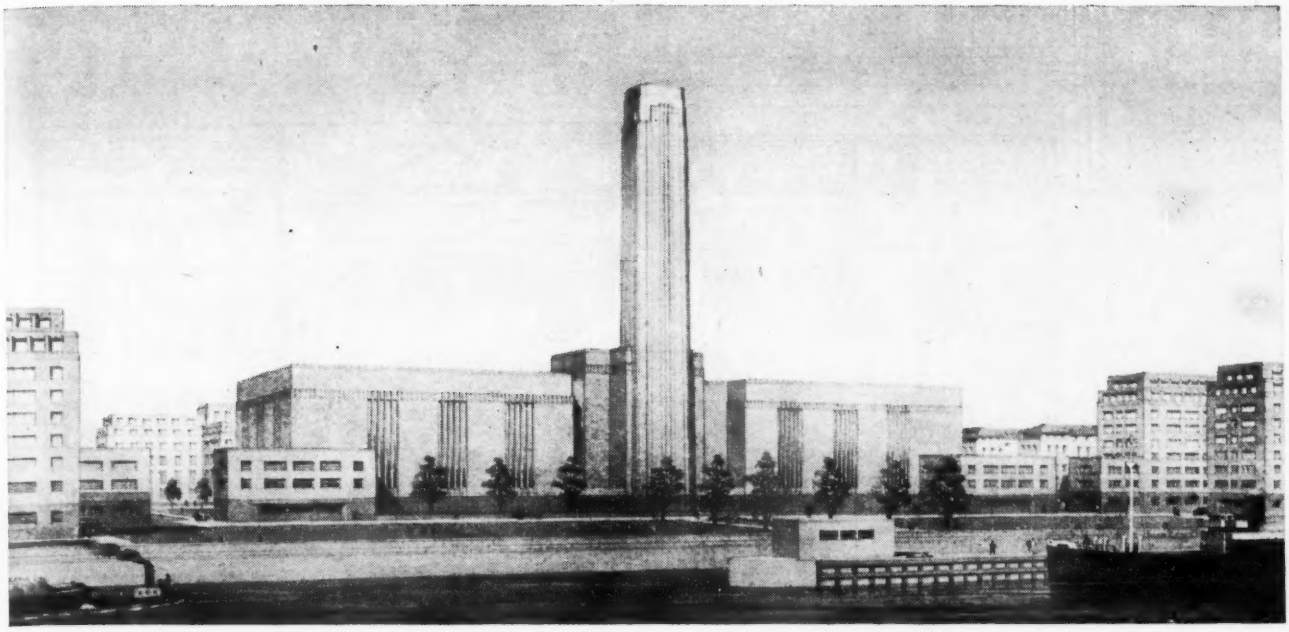
It makes a difference whether the driving unit is a squirrel-cage motor with high starting torque, a dc motor with comparatively low starting torque, or a gasoline or diesel engine with pulsating characteristics. Similarly, the load thrown on the drive depends on

(*Continued on page* 160)

TABLE II—RECOMMENDED CROSS SECTIONS OF V-BELTS FOR DIFFERENT MOTOR HORSEPOWERS AND SPEEDS

Motor horsepower	Motor speed 1800	1200	900	720	600	514	450
½–¾	A	A	A	—	—	—	—
1–1½	A	A	A	—	—	—	—
2–3	A or B	A or B	A or B	A or B	—	—	—
5	A or B	A or B	A or B	B	—	—	—
7½	A or B	A or B	B	B or C	B or C	—	—
10	A or B	B	B	B or C	C	—	—
15	B	B or C	B or C	C	C	—	—
20	B or C	C	C	C	C	—	—
25	C	C	C	C	C	—	—
30	C	C	C	C	C	—	—
40	C	C or D	C or D	C or D	D	D	—
50	C	C or D	C or D	D	D	D	D
60	C	C or D	C or D	D	D	D	D or E
75	C	C or D	C or D	D or E	D or E	D or E	D or E
100	C	D	D	D or E	D or E	D or E	D or E
125	—	D	D	D or E	D or E	E	E
150	—	D	D	D or E	E	E	E
200	—	D	D	E	E	E	E
250 and over	—	—	—	E	E	E	E

Note: When two belt sections are shown: If sheave pitch diameters are limited, use the smaller belt section. If sheave face widths are limited, use the larger belt section. If no limitations, use belt section providing the most economical drive.



BANKSIDE GENERATING STATION replaces old plant on the Thames River opposite famous St. Paul's Cathedral. Architectural features of plant building were designed to fit in with surrounding territory, which also dictated use of oil as fuel

London Plans First Oil-Fired Central Station in Britain

New Bankside Generating Station will have flue-dust removal equipment that will also remove sulphur compounds by washing. Ultimate plant will have four 60,000-kw turbine-generators

By H J RANDALL, *Managing Director, London Electric Lighting Co*

▶ FOR OVER 50 YEARS a generating station has stood on the Thames River in the heart of London, opposite St. Paul's Cathedral. More than three centuries ago this Bankside district was London's cultural and recreational center, but it has long since been industrialized. When a power plant was erected, almost on the Globe Theatre site where Shakespeare's plays had been produced, little thought was given to town planning, architectural beauty and smoke abatement.

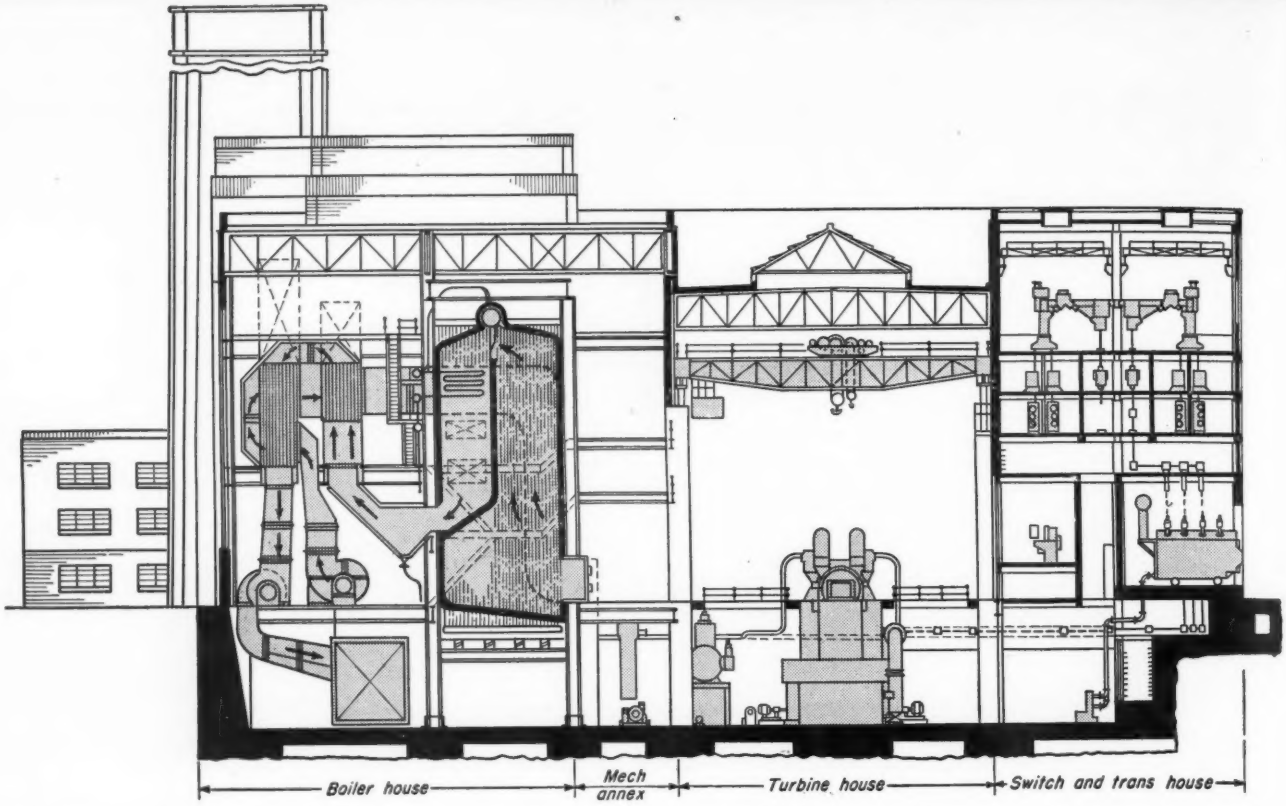
The station, designed for efficient operation at minimum cost, was a feature of engineering interest for visitors to London. In course of time it became obsolete, and in 1939 it was decided to rebuild. But World War II caused an indefinite postponement, so the station was operated despite much damage from enemy bombing.

In 1945 when rebuilding was again decided upon, there was wide public interest in town planning and smoke abatement. The London City Council, which produced a plan for new development of bombed areas, scheduled the Bankside district for offices, light industries and buildings for cultural purposes. The station owners decided that the new plant should be worthy of the rebuilt London. They commissioned Sir Gilbert Scott to design the building. Although the architect's design was admirable much opposition arose to rebuilding the station on its present site. The government settled the question by deciding that because of acute shortage of generating capacity and scarcity of sites in London the station should be rebuilt at the same location. It was stipulated, however, that oil should be used instead of coal. Hence, Bankside will become the first oil-fired station in Britain and the first of its kind in the world designed to prevent emission of flue gas with a high sulphur content.

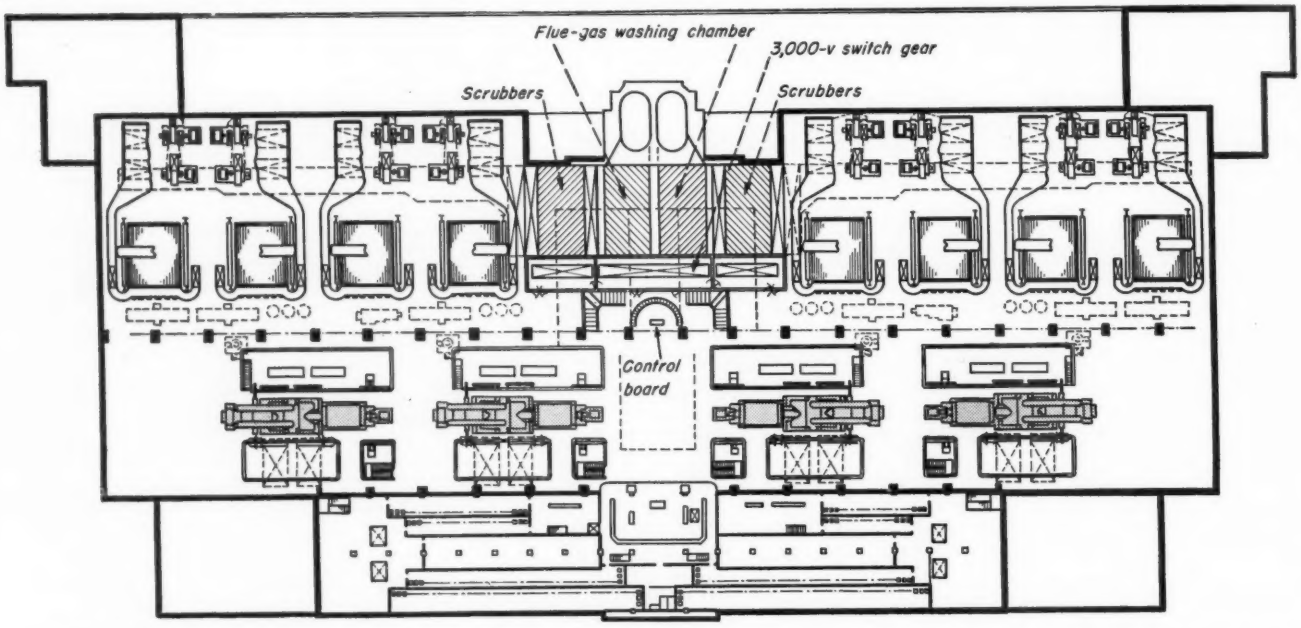
Building. The new building will be about 230 ft behind and parallel to the river bulkhead so space will be ample for a planned riverside boulevard. Foundation will be built on London blue clay about 34 ft below grade. Water-bearing ballast and silt overlie the clay, and the building area will be dammed off by steel sheet piles.

Wherever possible the circulating water tunnels will be deep enough to be driven into the clay, but some compressed air tunneling will be unavoidable. A river jetty will accommodate oil tankers and barges. Fuel will be pumped ashore through pipes in a tunnel between station and jetty.

Turbine-Generators. The 240,000-kw ultimate station capacity will be made



USE OF OIL FOR FUEL greatly simplifies plant layout. Eight boilers rated 300,000 lb per hr serve four 900-psig 900-F 1-in.-Hg backpressure turbines. The boilers are served by tubular air heaters and bare-tube economizers, two sets of fans



MAIN TURBINE-GENERATORS will be arranged lengthwise in turbine room with boilers in a single row in the boiler room. Flue-gas cleaning equipment for all units will be centralized about the stack located at plant center toward the river side

up of four 60,000-kw units. The first two are under construction. The units will operate with 900-psig 900-F steam and exhaust at 1-in.-Hg back-pressure. Five bleed points will give a final feedwater temperature of 380 F. The 2-casing tandem-compound units will have double-flow low-pressure casings and will turn at 3000 rpm. The alternators are designed for 3-phase 50-cycle 15,000-v 0.875-pf operation. Separately driven external fans will air cool the main generators.

Each unit will have twin condensers with a total surface of 50,000 sq ft arranged in two passes using 40,000 gpm (imperial). Duplicate 3-stage steam-jet air ejectors serve each unit.

Feedwater System. The 5-stage feed-heating system will have a drain cooler, low-pressure heater, gland steam condenser and deaerator on the suction side of the boiler feed pumps and three high-pressure heaters on the discharge side. This completely closed circuit will have water flow controlled by a closed feedwater valve, actuated by water level in the condensate receiver below the main condensers.

(*Continued on page* 166)

ELECTRONICS FOR THE POWER ENGINEER

By F A ANNETT, *Associate Editor*

8—Reactors and Transformers

▶ WE CONTINUE our study of inductance by considering some of the devices whose design and operation involve either self-inductance or mutual inductance. One of these is an inductive reactor, used in several forms in electronic and control circuits.

Inductive Reactor. An inductive reactor may have one coil, Fig. 1, or two, Fig. 2. When it has two coils they are wound so they magnetize the core in the same direction. In that way each coil assists in magnetizing the core. If the coils were connected in opposition as in Fig. 3, one would neutralize the magnetizing effect of the other and prevent them acting as an inductive reactance in the circuit. Sometimes resistance coils are connected that way to obtain a resistor in which the effects of inductance are negligible. Such a device is a noninductive resistor.

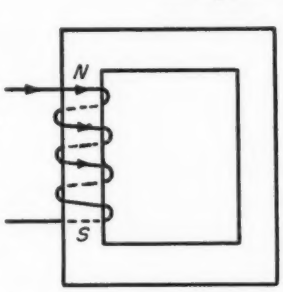
An inductive reactor in an ac circuit has the same effect as a resistor. For example, in Fig. 4, assume that when 2 amp flow in the circuit 35 v are induced in the reactor coil, which we will assume has negligible resistance. If 115 v is applied across the circuit only 115 − 35 = 80 v is effective across the 40-ohm resistor.

We get the same results in Fig. 5, where the reactor is replaced by a 17.5-ohms resistor. Total circuit resistance is 40 + 17.5 = 57.5 ohms. Current in amperes equals volts divided by ohms, or 115 ÷ 57.5 = 2 amp. A current of 2 amp through 17.5-ohms resistance causes a voltage drop of 2 × 17.5 = 35 v, the same as with the reactor, Fig. 4. But the reactor has the advantage of being constructed so it is easily adjusted by simple means like a saturating coil in what is called a saturable reactor. Also, the power losses are much smaller in a reactor than in an equivalent resistance.

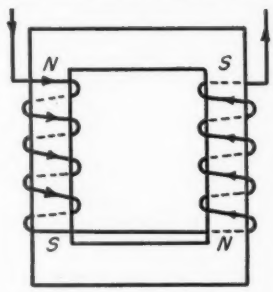
Saturable Reactor. A saturable reactor is a special inductive one through whose ac coil the current is controlled by a small dc current in a saturating coil. Since an inductance stores energy in its magnetic field, when current is increasing, and returns it to the power source when current decreases, its energy losses are low. Thus, with a saturable-core reactor many kilowatts of power load through its ac coils can be efficiently controlled by a few hundred watts of power in its dc coil.

When we start to magnetize a closed iron core the magnetic flux increases rapidly—in fact, almost directly in proportion to the current in the coil. Beyond a certain magnetizing current value, increase in flux becomes less and less for a given current increase. Event-

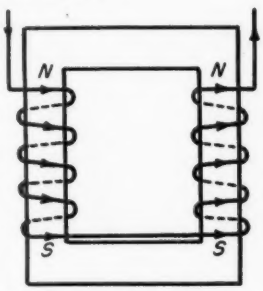
Simple and Saturable Reactors



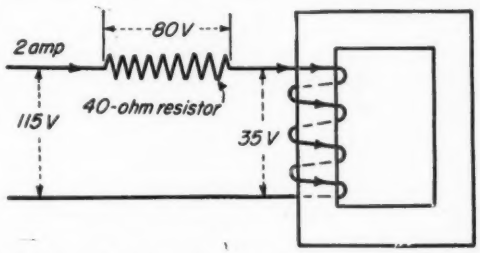
1 Single-coil reactor is fitted with 2-leg core



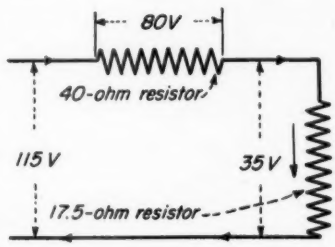
2 Double-coil reactor is fitted with 2-leg core



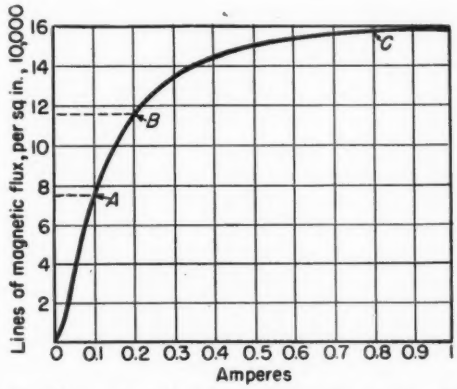
3 Reactor coils grouped for opposed polarities



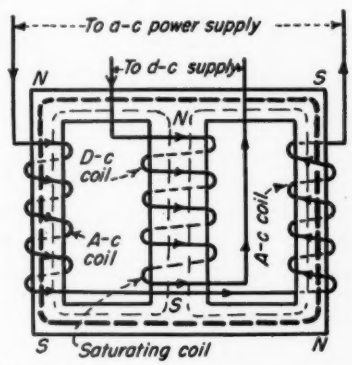
4 An inductive reactor in an ac circuit has the same effect as a resistor



5 Reactor, Fig. 4, is replaced by 17.5-ohm resistor for same voltage drop

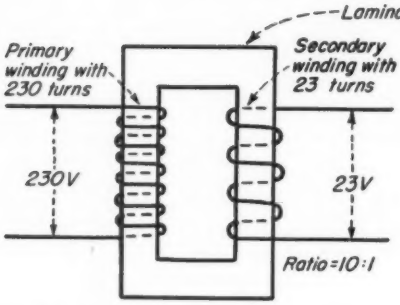


6 Magnetic-saturation curve for iron core like that in saturable reactor

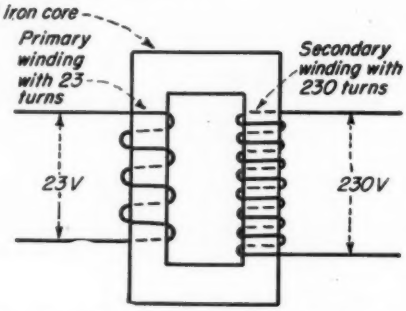


7 Saturable reactor has two ac coils and a dc coil on a 3-legged iron core

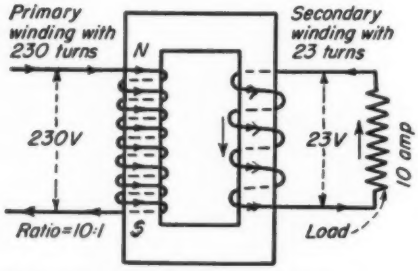
Two-Winding Transformers



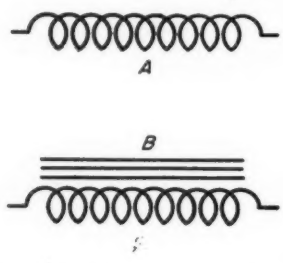
8 Simple arrangement of transformer connected to stepdown the voltage



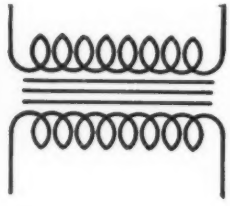
9 Transformer, Fig. 8, is connected to step up a low voltage to higher one



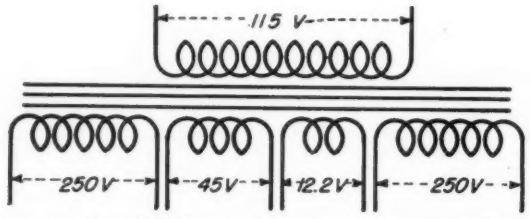
10 Load on secondary adds equal ampere-turns to primary and secondary



11 A: symbol for reactor without iron core. B: symbol with an iron core



12 This is the symbol for a potential transformer that has two windings



13 Stepup transformer has divided secondary for four different voltages

ually, a point is reached where an increase in current has practically the same effect as if the coil were wound in air. This effect, known as saturation, is shown in Fig. 6.

In the figure a current of 0.1 amp in the coil produces a core magnetic-flux density of 75,000 lines per sq in, point *A*. With 0.2 amp in the coil the magnetic flux increases to 118,000 lines, point *B*. A current increase to 0.8 amp gives about 158,000 lines per sq in. of core cross section. Beyond this point, flux-density increase is small no matter how much the current is increased.

In a saturable reactor we use a dc coil to saturate the reactor's core. To do this, we add a middle leg to the core and put the dc coil on it, Fig. 7. The ac coils are connected so their flux flows in the outside core, legs only, as indicated by heavy dotted line, and not in the center leg.

With the ac coils connected as they are and the current flowing ir them as indicated, the top end of the left-hand leg has an N pole as does the bottom end of the right-hand leg. If flux from the left-hand leg were to attempt to come down through the core's center leg it would be opposed by that from right-hand leg attempting to come up.

Consequently, one neutralizes the other and the total flux takes the path of the heavy dotted line. It is necessary to keep the ac flux from passing through the dc coil to prevent inducing a voltage in it by transformer action.

With current flowing as indicated in the dc coil, top end of the core's center leg has N polarity, and the bottom S. As a result the magnetic flux from this coil divides and passes through the two outside legs of the core and affects each of the ac coils in the same way.

With the dc coil dead the ac coils and core act as a conventional reactor. Under this condition these coils for a given current flow produce a maximum flux in the core. As a result maximum counter voltage is induced in the coils and current flow is restricted to the magnetizing value.

Assume that current in the dc coil is increased to where the core is saturated. The ac coils then act as if they were wound in air, consequently their inductance and counter-induced voltage is at a minimum. Under this condition current flow is at a maximum. Therefore, by adjusting current in the dc coil, current flow through the ac coils can be controlled from a minimum to a maximum.

Saturable reactors, as we will see in later articles, are used to regulate voltages, to dim lamps, to control electric-furnace temperature, to serve as a phase-shift device to regulate electron-tube output, and for other purposes.

What happens in an inductive reactor is the basic principle of the potential transformer, used extensively to change the voltage of ac circuits. These are built in many forms but the simple arrangement of two windings on a closed iron core, Fig. 8, is the most commonly used. The winding connected to the power supply is called the primary, and that to the load, the secondary.

For simplicity, in Fig. 8, assume that the primary winding has 230 turns and connects to a 230-v circuit. This voltage causes a current to flow in the winding and magnetizes the core. As this is ac the core is magnetized and demagnetized with each reversal of current. As the magnetic field builds up and decreases it is being cut by the primary turns, which induces a voltage in them, opposite to the applied voltage, as in the simple reactor.

Voltage induced in the primary winding of a well-designed transformer is almost equal to the applied voltage; consequently, current flow in this winding is low when the secondary winding is open. In this discussion primary induced voltage is considered equal to the applied voltage as it would be for a theoretical transformer—that is, the alternating magnetic field in the core induces 230 v in the 230 turns of the primary winding.

Stepdown Transformer. Assume a second winding on the core such as that marked secondary but having only 23 turns, 1/10 the number in the primary. Magnetic-flux loops through the secondary winding as it does through the primary, but is cut by only 1/10 the number of coil turns. Consequently, the secondary winding has only 1/10 the voltage induced in it as in the primary, 230 ÷ 10 = 23, as shown.

(*Continued on page* 132)

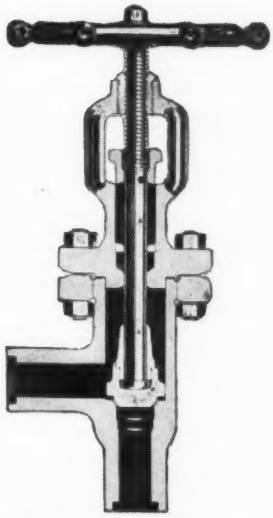
TEMPERATURE VARIATIONS, ABRASIVE SCALE NO PROBLEM WITH Edward BLOW-OFF VALVES

EASY OPERATION
Big knobbed handwheel, easy to grip even with oily hands.
LEAKPROOF BONNET
Welded integral or bolted, Edward blow-off bonnet joints won't leak.
PERFECT ALIGNMENT
Single set-up machining assures alignment of working parts.
ADJUSTMENT SIMPLE
Packing adjustment easy with through-bolted gland.
WEAR RESISTANT
Alloy seats and disks Stellite hard faced. (Stainless steel in lower pressures)
STREAMLINED
Nothing to prevent scale being blown completely through valve.
EQUALIZED CROSS-SECTIONS
No irregular masses of metal to distort on heating and cooling.

The vicious punishment of blow-off valve service—abrasive action of grit and scale—severe strains caused by violent temperature swings—finds its match in Edward blow-off valves.

Special hard surfacing equipment, developed at Edward, prepares seats and disks for a long life of resistance to the grinding wear of sediment blown through the valve at high velocities.

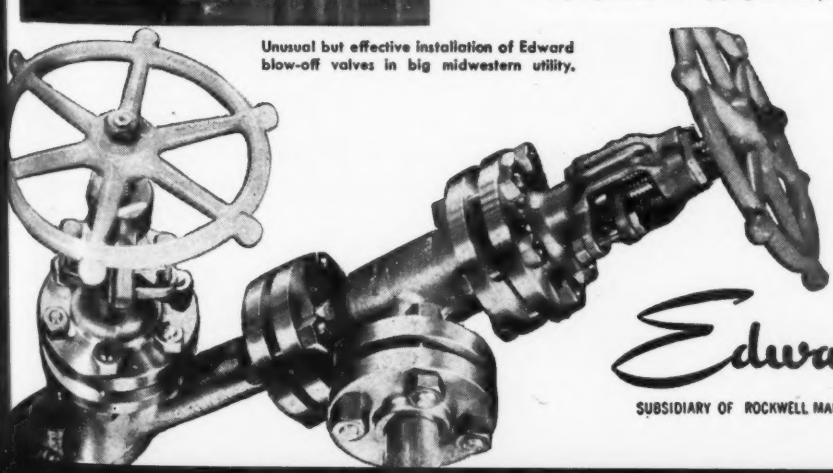
Metal sections of Edward blow-off valve bodies are engineered to compensate for the thermal distortion so that a valve closed tight under high boiler temperatures is still tight after cooling.



Typical Edward angle bolted bonnet blow-off valve. Choice of straightway or angle designs gives maximum piping flexibility.

LOW MAINTENANCE
PIPING FLEXIBILITY
SLOW OPENING
EASY REPACKING
TIGHT CLOSURE
LONG LIFE

Unusual but effective installation of Edward blow-off valves in big midwestern utility.

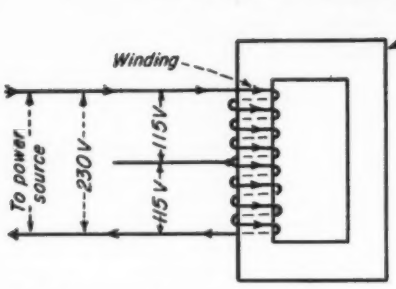


Edward builds blow-off valves for 150 lb to 2500 lb boiler service. Write for Catalog 12-D.

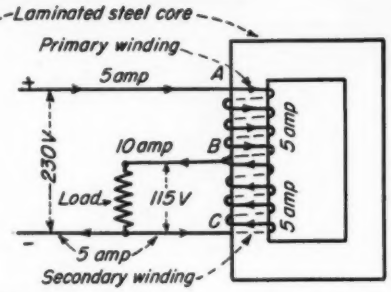
Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO EAST CHICAGO, INDIANA

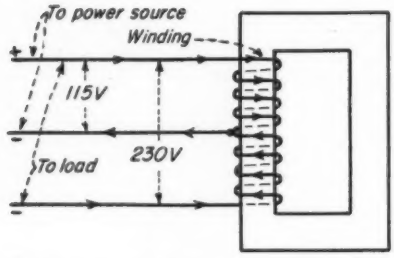
Auto and Peaking Transformers



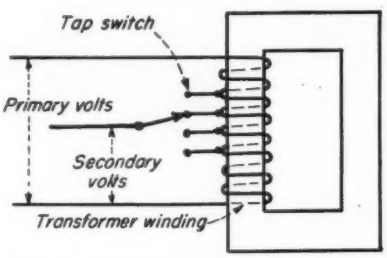
14 Autotransformer has primary and secondary coils combined in one



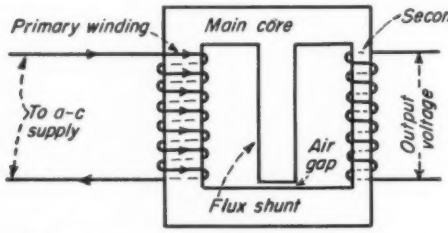
15 Load connected to autotransformer so as to obtain one-half voltage



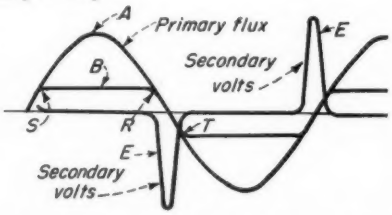
16 Autotransformer connected for increased voltage on the secondary



17 Autotransformer has tap switch to change the secondary output voltage



18 Peaking transformer produces voltage with sharp peak in secondary



19 Primary flux and secondary voltage curves for the peaking transformer

This is what is called a step-down transformer, that is, it reduces voltage from a higher to a lower value.

Ratio of primary to secondary volts is called the transformer's ratio, which in Fig. 8 is 230:23. Dividing each side by 23 gives a ratio of 10:1.

This transformer could be used to step up the voltage by connecting the low-voltage winding to a 23-v supply when 230 v will be obtained on the high-voltage winding. In this case the low-voltage winding becomes the primary, and the high-voltage the secondary.

The transformer's ratio is now 23:230, or 1:10. Secondary volts of a transformer equal the primary volts divided by the ratio. In our step-down transformer it was $230 \div 10 = 23$ v, and in the stepup $23 \div 1/10 = 230$ v.

Since the voltage induced in the primary winding opposes the applied volts, voltage induced in the secondary must be in opposition to the applied volts. Therefore, when the secondary is connected to a load, current flows in it opposite to that in primary winding.

Assume the secondary winding connected to a 10-amp load, Fig. 10. This current flows in the secondary winding opposite to that in the primary, as shown. Secondary current then tends to demagnetize the core, whereas primary current magnetizes it.

We assumed the secondary to have 23 turns, therefore with 10 amp in this winding there will be $23 \times 10 = 230$ ampere-turns tending to demagnetize the core.

Just as soon as the core starts to demagnetize, induced voltage in the primary decreases, because this winding is cutting a smaller number of magnetic lines. Since the counter voltage in the primary is reduced there is a greater effective voltage to cause current flow and the primary current increases. This increase is theoretically equal to a current that will add the same number of ampere-turns to the primary as exists in the secondary.

Since the primary has ten times as many turns as the secondary, the former requires only 1/10 the amperes to have the same number of ampere-turns, or $10 \div 10 = 1$ amp. This gives $1 \times 230 = 230$ ampere-turns, the same as in the secondary, 10 amp would be required in the primary winding to give equal load ampere-turns in each winding. Secondary and primary load ampere-turns neutralize each other theoretically and leave the primary magnetizing ampere-turns the same as before the load change.

Symbols. To indicate inductive reactors and transformers in electric circuits as they have been shown here would be inconvenient and frequently cause unnecessary complications and work. So they are usually represented by symbols. Fig. 11-*A* shows the symbol for a reactor without an iron core, while Fig. 11-*B* is the symbol for one with an iron core, the core being represented by three straight lines. Fig. 12 shows the symbol for a transformer. In it the core is represented by straight lines as for the reactor.

A transformer may have one primary and several secondary windings to supply voltage for different purposes in an electronic system. For example, the one in Fig. 13 is used in a flame-failure protective system for gas- or oil-fired furnaces, which we will discuss in a later article. In such an arrangement the secondary is a voltage divider in which the total secondary voltage of 557.2 v is divided, 250, 45, 12.2 and 250 v to energize different circuits.

Autotransformers. Some times primary and secondary coils are combined in one winding, Fig. 14, called an autotransformer. A tap from the winding is the secondary or primary depending on how the transformer is used. In stepdown operation, if the coil terminals connect to a 230-v source, 115-v secondary voltage is obtained from a center tap and either outside leg as shown. The winding being connected across 230 v has practically this voltage induced in it, so at the winding's midpoint, voltage is one half the total.

If a load is connected to the secondary as in Fig. 15, at a given instant current flows from the terminal marked + through the winding to the middle tap, the load, and to the — line. Load current in winding *AB* increases the flux in the core to raise the induced counter voltage in winding *BC* to where current flows through the load.

This winding now acts like the secondary of a 2-winding transformer, with its current flowing opposite to that in

(*Continued on page* 164)

GUN-PAKT
EXPANSION JOINTS
Reduce Steam Line Maintenance

Steam line maintenance is simplicity itself when Yarway Gun-Pakt Expansion Joints are on the job.

There's no need for costly shutdowns and heating interruptions to service joints. *It's all done under full steam pressure.* Insert a plug of packing, turn a wrench, the joint's tight.

Maintenance costs are exceptionally low. For example, one utility spends 65 cents per year per joint ... another less than half that.

Whatever your expansion joint needs may be, investigate GUN-PAKTS. They will save you money.

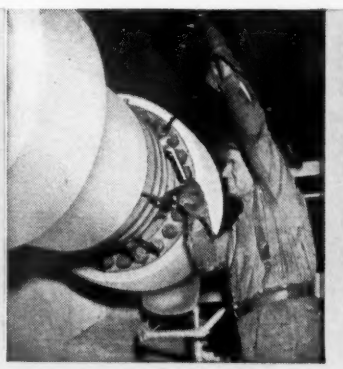
FOR FULL DETAILS WRITE FOR FREE BULLETIN EJ-1912

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.

Serviced

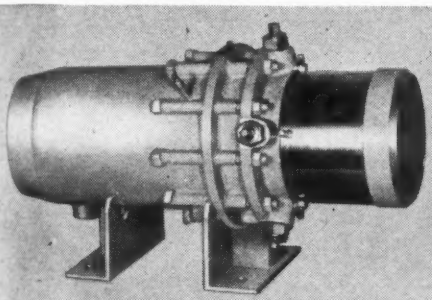
UNDER FULL STEAM PRESSURE

1. INSERT YARWAY PACKING.



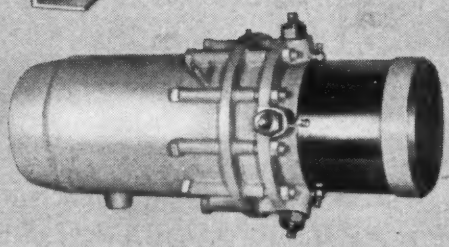
2. TURN A WRENCH.

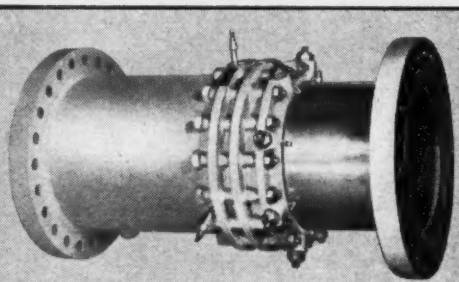
THE JOINT'S TIGHT . . . THE JOB DONE



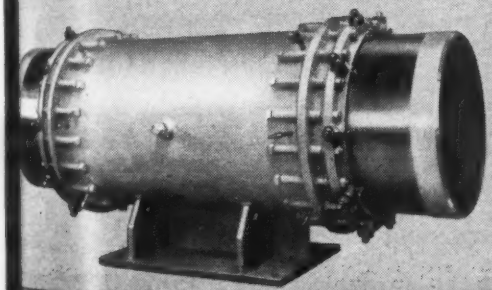
SINGLE END WELDING TYPE with base 150 lbs. pressure

SINGLE END WELDING TYPE without base 50 lbs. pressure



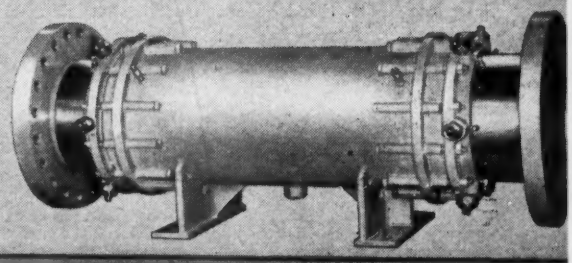


SINGLE END FLANGED TYPE without base 400 lbs. pressur



DOUBLE END WELDING TYPE 150 lbs. pressure

DOUBLE END FLANGED TYPE 300 lbs. pressure



YARWAY GUN-PAKT EXPANSION JOINT

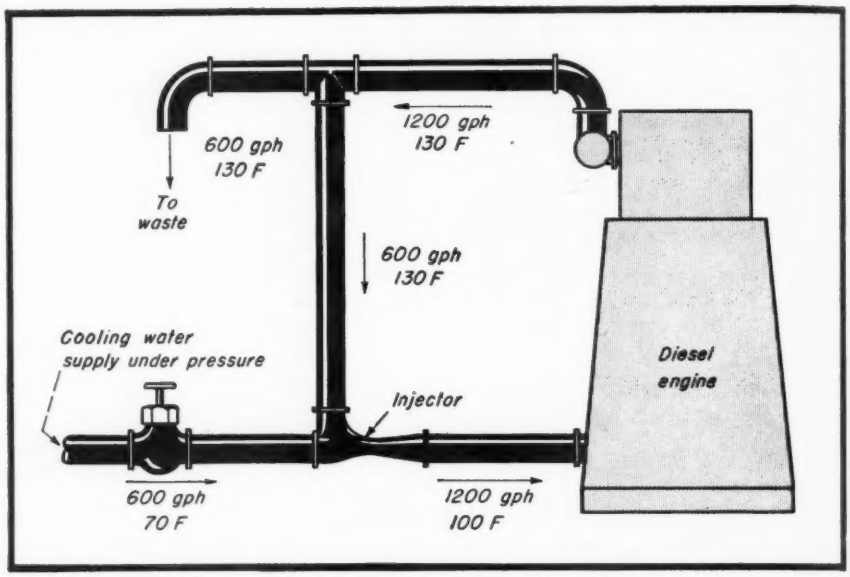
POWER ENGINEERS' NOTEBOOK

PLANT-TESTED IDEAS TO SOLVE PROBLEMS OF DESIGN, OPERATION AND MAINTENANCE

RECIRCULATING COOLING SYSTEM IMPROVES ENGINE OPERATION

When engine cooling water comes from supply mains under pressure, an injector can be used to recirculate part of the water through the engine. The hookup is illustrated in the sketch that is shown at the right. The first cost for the piping and the injector is low, the operating cost is zero, and the system proves to be both simple and reliable with better engine performance.

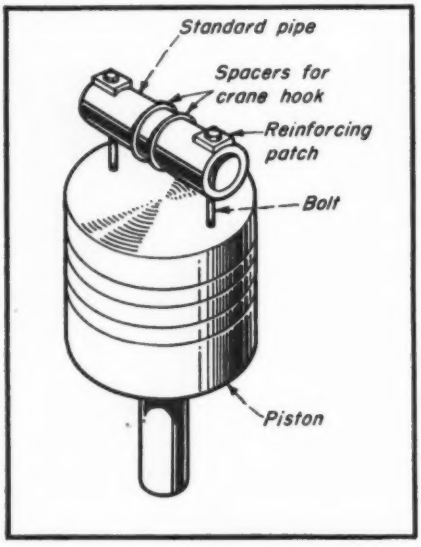
Engine operation improves because (1) cooling water entering engine at higher temperature causes more uniform expansion of parts (2) warmer cylinder jackets eliminate condensation of water vapor in crankcase, which may materially shorten life of lube oil (3) doubled water flow through jackets increases heat transfer, eliminating hot spots and also helping to reduce scaling of jacket walls.



In one installation for which the figures are given in the sketch, the injector draws in an amount of water from the discharge line equal to the water under pressure. Mixing the two waters raises the inlet temperature into the engine as shown. Increased water flow through engine is effected with use of only one-half the amount from the mains. Water overflow must be higher than the engine.

D F Bixler *New York, N. Y.*

PULLER BARS SAFELY REMOVE PISTONS AND HEADS



Pulling cylinder heads and pistons entails a certain amount of danger. To minimize the hazards to both personnel and equipment we designed puller bars for this job. A puller bar for the piston, like the one in the sketch, was built to proper dimension for the head.

Standard pipe was used for the bar, which was cut to proper length and had holes drilled at the correct spacing to accommodate the pulling bolts. Reinforcing patches were welded on where the bolts would seat. Rod iron was fitted to circle the pipe and then, after proper spacing to accommodate the crane hook, was welded in place. For the pulling bolts a washer was welded at the bolt heads to allow greater purchase on the reinforcing patches.

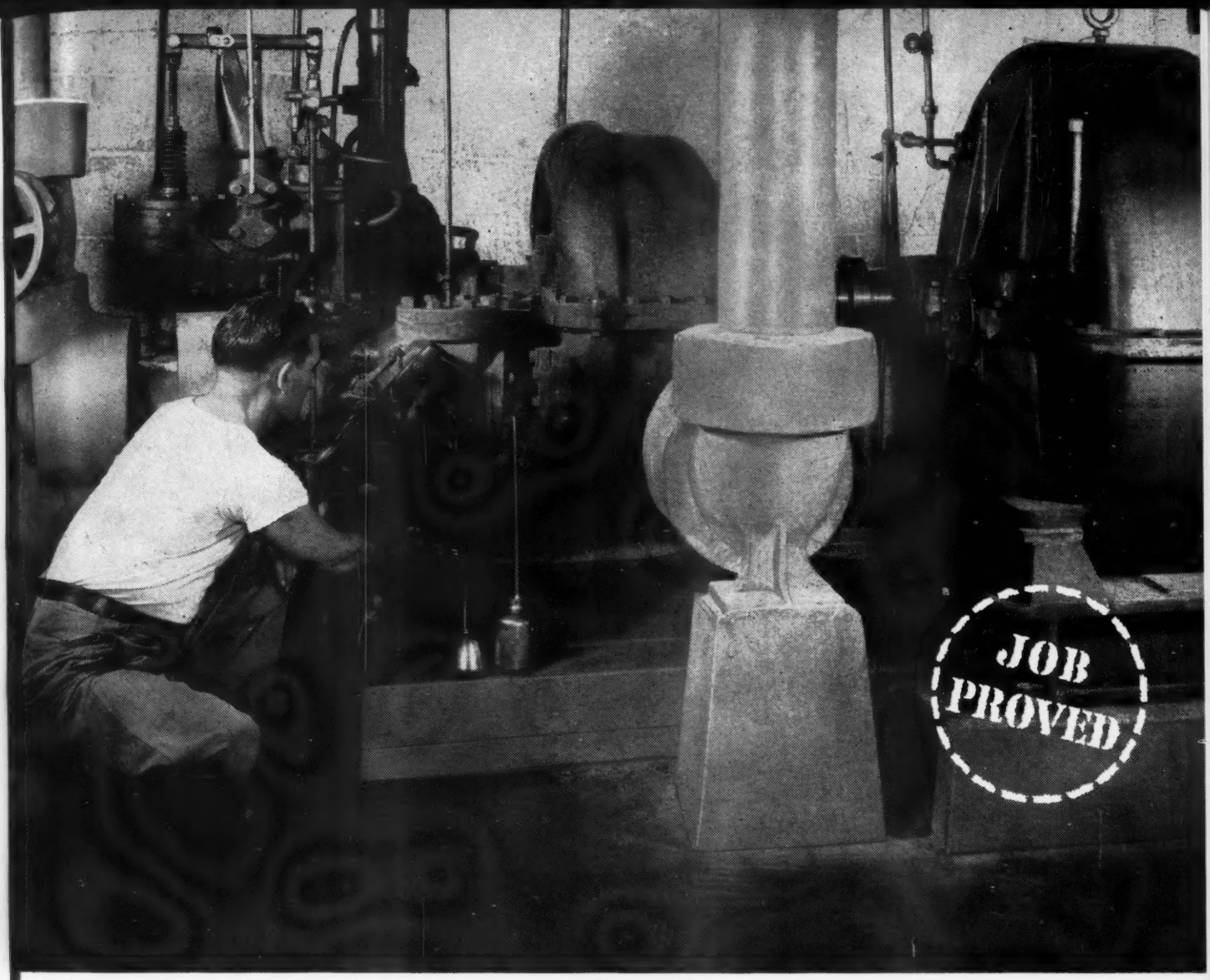
These puller bars shorten the distance between piston and crane hook. because the hook connects directly with the bar. This eliminates waste space. Rod-iron size for the spacers depends upon crane-hook dimensions.

When using the bars pull the hoisting chain up snug before attempting to lift head or piston. Then shake the chain to loosen the piston or head. When sure the piece is free, complete the removal.

Some engine manufacturers supply conventional eyebolts for these removal operations, but they will occasionally bend at the threads from slack in chains and spacer block and break.

James F Maher *Shiprock, N. M.*

(*Continued on page* 136)



NO SLUDGE, NO RUST, NO CORROSION

Sunvis 900 Oils Still Like New After 3 Years' Service — Gears and Bearings Show No Wear

In October 1945 a paper mill started up a turbine which had been idle during the war. Sunvis 900 Oils were put in the circulating system and the bath-lubricated gear reduction unit. The operating temperature was about 140°F.

Today, nearly three years later, this equipment still runs on Sunvis 900 exclusively. It requires little makeup. The oils go unfiltered and untreated. No sludge has formed. During the last two summers the equipment stood idle for a few months, exposed to inevitable condensation. Inspected recently, the gears and bearings showed no measurable wear, and were free from rust and corrosion, despite the intermittent operation. The oil is in excellent condition, although never changed.

In all major industries, similar excellent results are being obtained by companies which have adopted Sunvis 900 Oils for preventive maintenance. Sunvis 900 Oils are fortified to resist deterioration and to protect metal parts against rusting and corrosion. These long-lasting, top-quality oils *keep productive machinery running longer*. They can do the same for you. Call your nearest Sun Office, or—for a copy of the illustrated booklet "Sunvis 900 Oils"—write Department P-12.

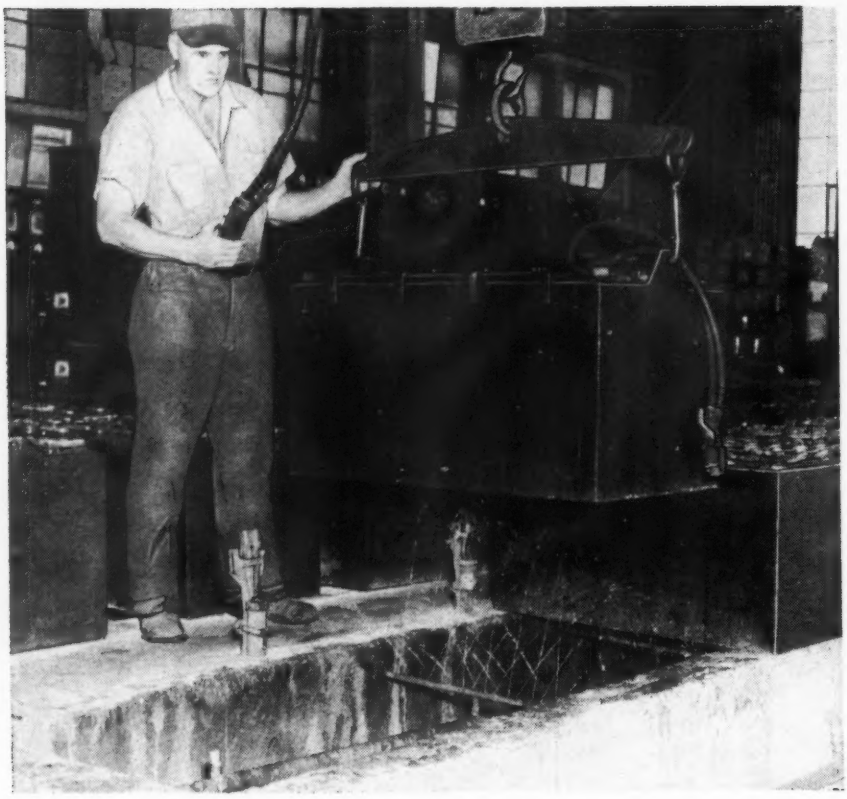
SUN OIL COMPANY · *Philadelphia 3, Pa.*

In Canada: Sun Oil Company, Ltd.
Toronto and Montreal

SUN PETROLEUM PRODUCTS
"JOB PROVED" IN EVERY INDUSTRY

SUNOCO

 (*Continued from page 134*)

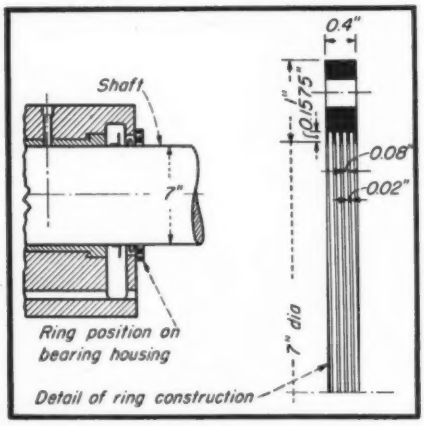


Water-Cooled Battery Charging Speeds Process

ENGINEERS OF the Reynolds Alloy Co, Listerhill, Ala., faced with reduction of industrial truck availability caused by round-the-clock operation, devised a system for cooling storage batteries while on charge. This allows faster charging and keeping trucks in operation for three shifts on only two sets of batteries per truck. In addition to eliminating need for a third set of batteries this system prolongs battery life by preventing the excessive temperature that is developed by accelerated charging.

The charging racks are long concrete pits with individual spray pipes installed under each charging position. Batteries taken directly from trucks are placed over the pits for recharge and immediately receive the cooling effects of the spray.

The charging station, accommodating 54 batteries, also features an air-water nozzle for cleaning and drying the batteries as well as a vat for repainting them.



Grooved Ring Stops Oil Leakage Along Shaft

WHEN BEARINGS are lubricated under pressure it sometimes proves difficult to stop oil leaking out along the shaft. Cotton or felt packing usually proves ineffective. A ring with grooves running contrary to direction of shaft rotation, mounted as shown, will stop all leakage while the shaft turns. This has proved effective even with vibrating shafts. The ring sketched has screw-shaped threads with a double pitch. These grooves cause oil backflow that stops leakage.

D WIJSMAN
Suriname, Dutch Guiana

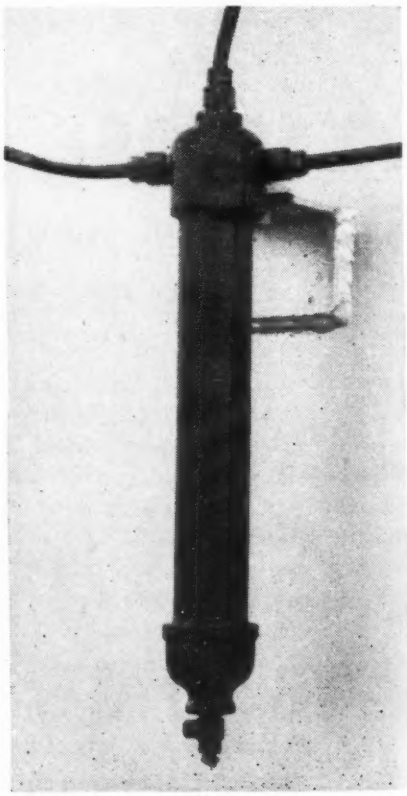
SEDIMENT TRAP IMPROVES PERFORMANCE OF REGULATING AND RECORDING INSTRUMENTS

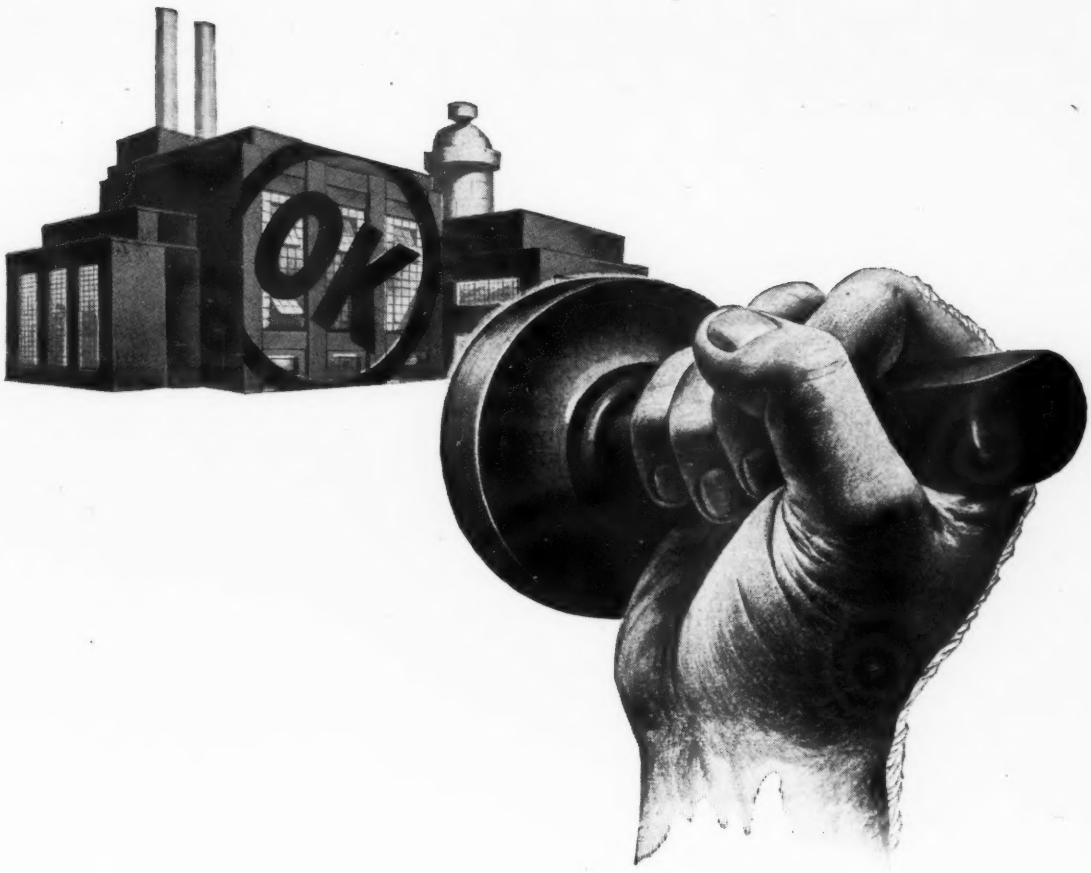
INSTALLATION of a sediment trap in the line between high-pressure gas main and regulating and recording instruments not only reduced down time of the instruments but also eliminated slugging of condensate with consequent inaccuracies in the control-device functioning.

Trap was made of a 10-in.-long section of 2-in. pipe fitted with 2 to ¼ in. reducers at each end. Reducer at the bottom carried a petcock for cleanout purposes, while the upper reducer was equipped with two side inlets, also ¼-in. pipe size. The top tap from line pressure carries the lead down to about midway of the body. The side taps lead to the instruments and control devices.

Temperature changes and occasional bleeding of the instrument lines caused slight condensation in the trap. Collection was slow but enough to affect instrument accuracy eventually. Rust and hydrate crystals, collected during the winter, were periodically removed by blowing down through the petcock at the bottom.

ELTON STERRETT *Houston, Tex.*





can your Boiler Plant meet this *Test?*

Stop for a moment and consider *your* boiler plant. Can you, as a power plant engineer, honestly give your plant an OK for completely successful operation . . . especially its water conditioning? Efficient water conditioning starts with the raw water supply and continues through the plant, taking in many problems.

Correct water conditioning is a matter of careful and scientific control.

W. H. & L. D. BETZ is an organization of engineers and chemists specializing in the solution of all industrial water problems. Years of experience have made Betz water conditioning service scientifically correct . . . complete . . . economical.

Our nationwide staff of engineers will welcome the opportunity of discussing with you this important subject of water conditioning . . .
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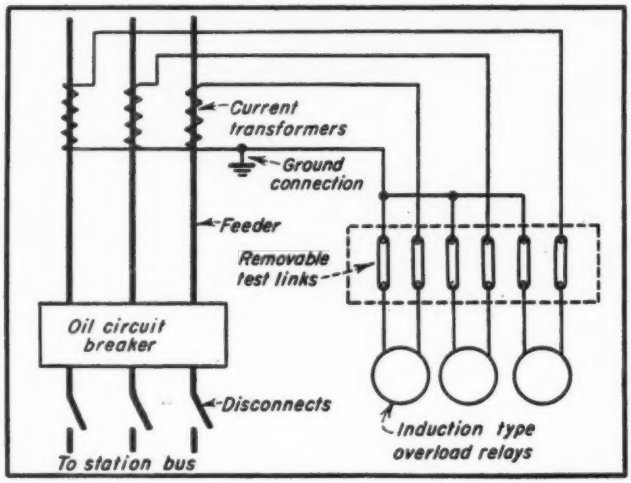
PROBLEMS FROM THE PLANT

Exercise your engineering wits by submitting answers to this question, fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

HOW CAN WE CHECK CURRENT-TRANSFORMER SECONDARIES?



ALTHOUGH WE PERIODICALLY CHECK the overcurrent relays on all our plant feeders, we never gave serious thought to the relay current transformers. After the relays failed to operate on a recent cable fault, we made a quick check and found them OK, but two of the current-transformer secondaries were shorted.

We fully realized, even though we made a thorough check on all relays, it meant nothing if the ct was shorted.

That started a systematic check on all current transformers. Using a series test lamp from a 120-v source, we spotted six ct's with shorted secondary windings. The test consisted simply of noting the brightness of the test lamp in series with the transformer secondary. A dim light showed the winding OK while a bright light indicated a shorted secondary.

We know this is but a rough check since it doesn't tell when only a few turns are shorted. The correct turn ratio is mighty important since it will determine the tripping point of the connected relays. We would appreciate hearing how POWER readers check ct's in their plants. We have been thinking of making a simple impedance test. Would ammeter and voltmeter readings using a low voltage ac source do the trick?—*CA*

Readers' Answers

How Often Should We Resocket Elevator Ropes?

(This question is from September issue with best answers from readers.)

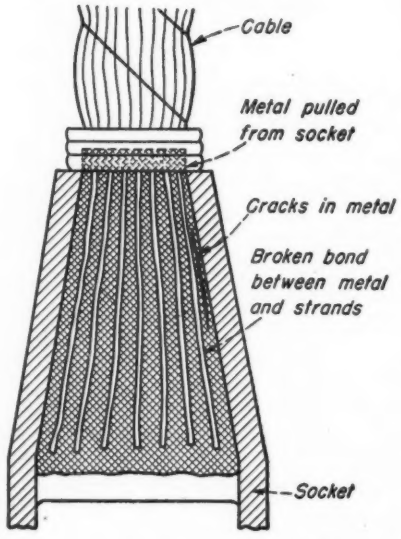
WE HAVE BEEN discussing the question of how frequently we should resocket elevator ropes, but are unable to come to any agreement. There seems to be a wide difference of opinion on this subject even among the experts.

One concern, which manufactures and maintains drum elevator machines, resockets the car hoisting ropes each year on overhead machines, and every two years on basement machines. The Bureau of Standards circular, "*Elevator Wire Rope Maintenance*," recommends resocketing all ropes each year on overhead machines, and every two years on basement type.

It has been our experience that, under normal operating conditions and with proper maintenance, these ropes seldom show signs of fatigue at the sockets during their life span.

We would certainly appreciate the opinion of POWER readers on this question with regard to both the drum and traction type of elevators.—FAA

Recommends Biannual Resocketing of Ropes



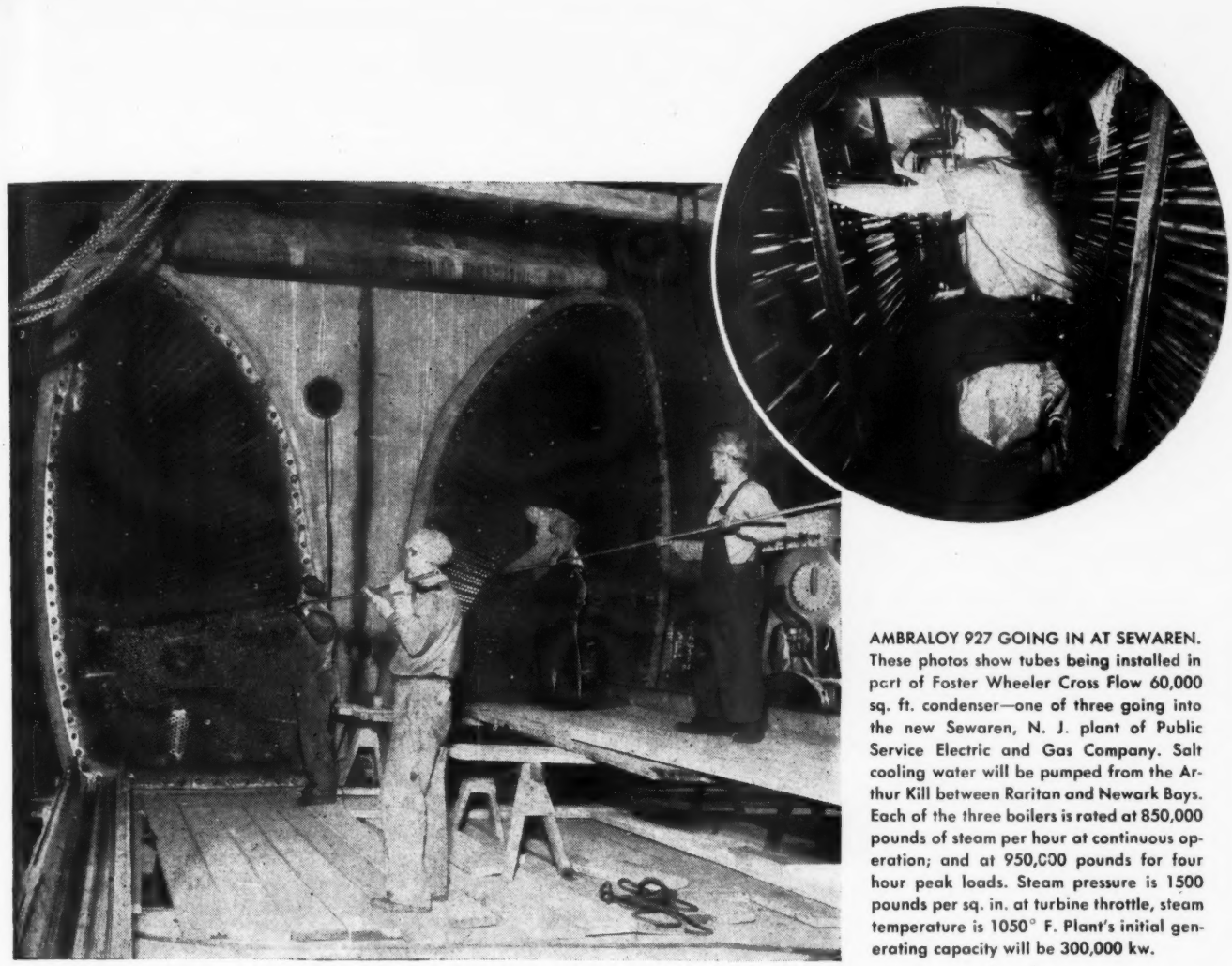
FREQUENCY of elevator-rope resocketing is dependent upon rope wear near the socket and condition of metal in the socket. Annual and biannual resocketing schedules are based on conservative estimates of the effective life of metal in the socket. In general, it is best not to exceed these limits, regardless of the condition of rope near the socket. Rope outside the socket may appear to be as good as new, but trouble may have started within the socket where it cannot be seen by casual inspection.

As shown in sketch at left, there are several factors that may cause trouble within socket. Cracks may occur in socket filler metal and under certain conditions the metal may be partly pulled out of the socket, or the bond between the metal and rope strands may be broken. Since these conditions are difficult to detect, frequent resocketing is the easiest way to prevent them.

Resocketing is an inexpensive and effective way of providing safe connections for all types of elevator ropes. *FAA* will find that the added safety and peace of mind provided by frequent resocketing is well worth the cost. Hence, resocketing should always be done annually or biannually according to the type of elevator.

TYLER G HICKS *New York, N. Y.*

(*Continued on page* 140)



AMBRALOY 927 GOING IN AT SEWAREN. These photos show tubes being installed in part of Foster Wheeler Cross Flow 60,000 sq. ft. condenser—one of three going into the new Sewaren, N. J. plant of Public Service Electric and Gas Company. Salt cooling water will be pumped from the Arthur Kill between Raritan and Newark Bays. Each of the three boilers is rated at 850,000 pounds of steam per hour at continuous operation; and at 950,000 pounds for four hour peak loads. Steam pressure is 1500 pounds per sq. in. at turbine throttle, steam temperature is 1050° F. Plant's initial generating capacity will be 300,000 kw.

Public Service of New Jersey installs Ambraloy 927

. . . the tubes "that protect themselves"

IN CONTACT WITH SEA WATER, Ambraloy 927 Condenser Tubes rapidly form a strong, continuous-surface film of aluminum oxide. It is this *protective* coating that gives Ambraloy 927 Tubes their remarkable resistance to the corrosive "impingement" attack of aerated sea water flowing at a relatively high velocity.

Ambraloy 927 Condenser Tubes (aluminum brass alloy) are establishing noteworthy economy records aboard high speed ocean liners and in heavy duty steam turbines ashore—especially at some of the larger central power stations where sea water, including polluted harbor water, is used for cooling.

Engineers and equipment manufacturers are invited to consult our Technical Department in determining the most suitable alloys for specific heat exchange requirements. For general information on Anaconda Condenser and Heat Exchanger Tubes and Tube Sheets, send for Publication B-2. 48140

ANACONDA
from mine to consumer

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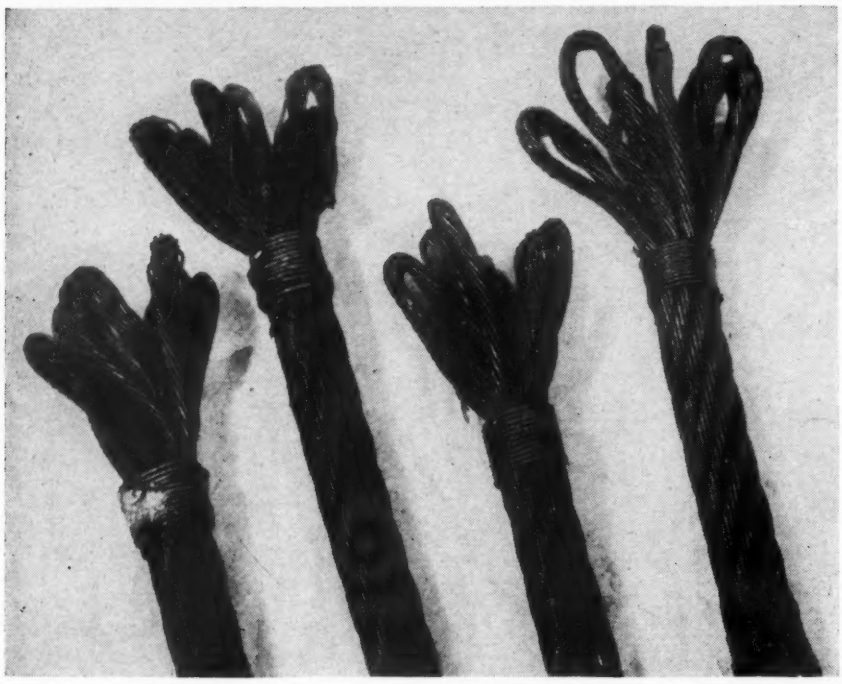


GOOD JUDGMENT NEEDED IN APPLYING RULES

FAA's QUESTION has been thoroughly considered by engineers in elevator, wire-rope and insurance companies as well as by government safety and other interested bodies. So far no standard practice has developed. An example of its lack is evidenced by the difference between the practice of elevator companies and the recommendations of U. S. Bureau of Standards, cited by *FAA*.

To set up safety rules, like those of the Bureau of Standards, that always insure safe operation, the worst conditions must be assumed and rules written for them. These would apply in damp buildings where elevators get little attention while being in practically constant service. We may add that the elevator machine produces vibration in the ropes, while poor brake adjustment stops the car suddenly. Ropes on such drum elevators probably require resocketing each year, and also frequent replacement.

At the other extreme are elevators that operate under ideal conditions. They receive intelligent care, including proper rope lubrication. Under these conditions, ropes can probably pass their useful life without resocketing except when they are shortened. This can be done at both ends if there is any doubt about the condition at sockets.

During a long experience, in which I have inspected hundreds of drum-type elevators, I remember only one case where ropes showed signs of fatigue at the sockets. These ropes, which were on the car counterweights, had never been lubricated in nearly 20 years' service in a damp industrial building. With proper care the wires would probably not have broken at the sockets.

This does not mean that elevator ropes should be resocketed only once every 20 years. It does tend to show, however, that anyone who resockets every year or two is probably leaning over backwards to be on the safe side. No doubt elevator ropes have failed at their sockets, but I have never heard of one case. I do know of several failures between sockets.

Recently I inspected conditions at the counterweight sockets of ropes on a high-speed traction elevator. They were renewed after 10 years heavy service; the photo shows four of the six terminals. One of the other two was taken apart and the wires carefully inspected for fatigue. They were apparently in as good condition at the terminal thimbles as in the straight rope.

These ropes had been intelligently installed, maintained and lubricated, but operated on an elevator in heavy-duty passenger service. They were renewed because wires were worn and broken where they run over the sheaves.

Elevator ropes generally have to be shortened every two or three years so that at least they must be resocketed at one end. This is all that is necessary under most conditions. While resocketing one end, an intelligent inspection of the other should show any deterioration. If it does, resocket other end also.

R O SPENCER *Philadelphia, Pa.*

For Light-Duty Service Resocket Every Five Years

AFTER MANY YEARS of experience we settled on a rule of thumb that calls for resocketing elevator ropes every five years. But this cannot be taken as the standard since our cars are in slow, light-duty service. Generally speaking, I find most elevators are resocketed every two years. From this I suggest *FAA* use his car speed and duty as the governing factor in setting up his resocketing schedule.

One important thing to keep in mind when dealing with drum-type machines is that most of them have only two lifting cables. These terminate on the car in rigidly held thimbles. Continual vibration eventually causes crystallization at the point where the cable terminates in the mouth of the thimble. Shackles, on the other hand, carry vibration clear through to the nut on the spindle. This is shown by wear on the threads and burnishing of upper side of top nut.

Keep in mind that, where only two cables support the car, snapping of one cable invariably results in the other cable letting go. The extra burden is transmitted through the equalizing bar giving the remaining cable a jolt beyond its safety limit.

H H BRYAN *Montreal, Canada*

Use Inspection as Basis For Resocketing Schedule

IT WOULD BE WISE for *FAA* to determine his resocketing schedule by inspecting all rope sockets frequently. If inspection shows a number of broken strands at the socket or a distortion of the strands so the load is not evenly distributed in the rope, then it should be resocketed.

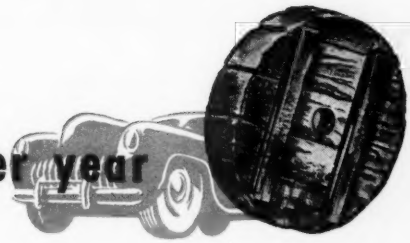
If the rope is properly resocketed the joint has a strength of about 80% of the rope's breaking strength. So it would seem unnecessary to resocket unless fatigue signs are found as a result of frequent inspections. Incidentally, the job lasts longer and is safer if the strands are arranged to emerge from the socket in their correct helical lines without distortion.

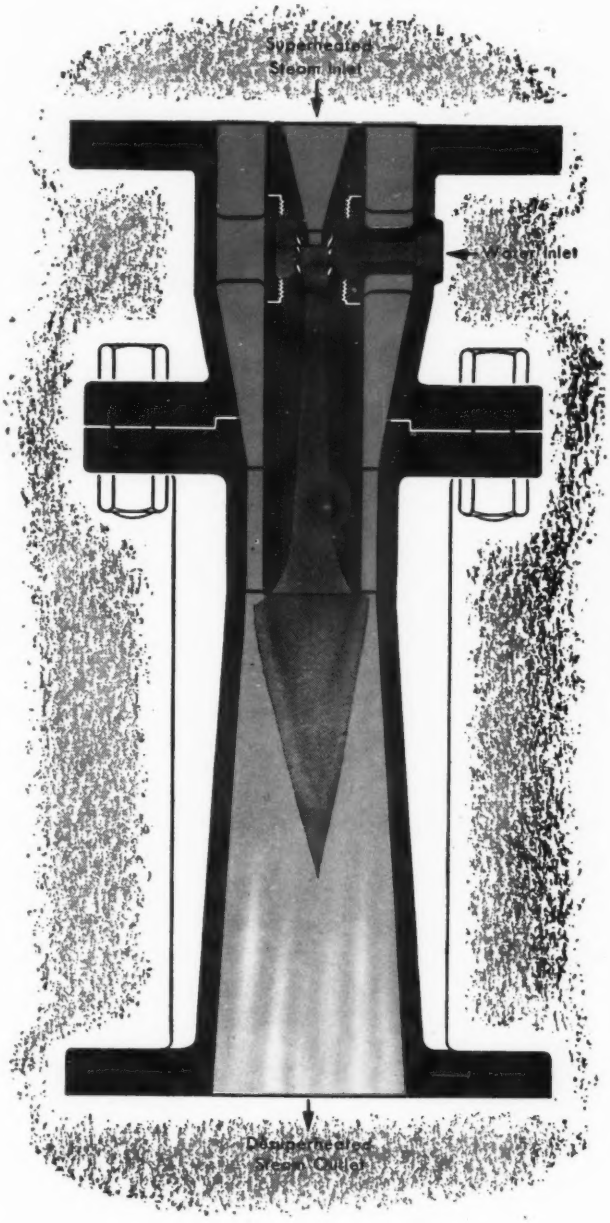
V C SUMMER *Parr, S. C.*

(*Continued on page* 172)

an SK "reason why"

provides high efficiency year after year





An ancient discovery, the wheel . . .
Symbolizes the efficiency of simple design.

An SK Venturi Type Desuperheater . . .
Employs the simplicity of the jet . . .
To desuperheat steam efficiently . . .
Year after year.

This type is particularly applicable . . .
Where steam flow varies widely . . .
With consequent changes in water flow.

In operation, the Venturi Type . . .
Increases steam velocity in the venturi . . .
And introduces water in small streams . . .
At the point of greatest turbulence . . .
To discharge the fog-like mixture . . .
Into the main steam flow.

An SK Venturi Type Desuperheater . . .
Offers a 1 to 10 capacity range . . .
Requires water pressure equal only to steam . . .
Takes no more space than the pipe . . .
And has a low pressure drop.

SK Venturi, Absorption and Spray Types . . .
Are fully described in Bulletin 6-D . . .
Which is available upon request.

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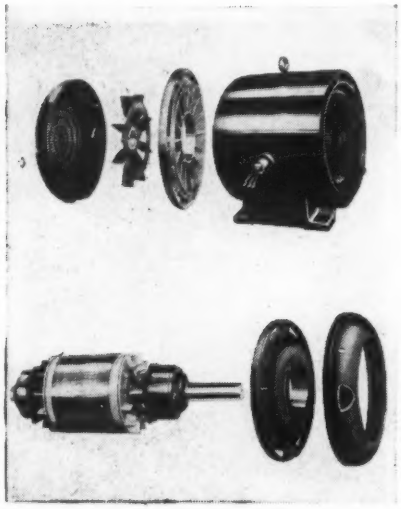
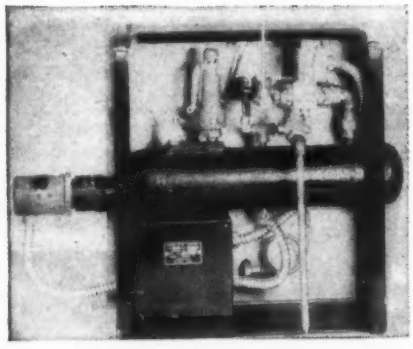
NEW PLANT EQUIPMENT



Explosionproof Motor E500

A LINE of totally enclosed fan-cooled motors has ratings of 200 hp and speeds of 3500, 1750, 1160, or 870 rpm for 550 v or less. They are also available at a rating of 150 hp at the same speeds for operation on 2300 v. Motors are approved by the Underwriters' Laboratories for hazardous locations, and feature a cast-aluminum rotor with heavy-duty ball bearings and one-piece cast-iron frame with an externally mounted fan. **Wagner Electric Corp, 6400 Plymouth Ave, St. Louis 14, Mo.**



Return-Line Treatment E501

A NEW FULL-AUTOMATIC UNIT treats steam-heating and process systems beyond the boiler. The new unit has a continuous-discharge cycle, whereas previous hand-loaded model worked on 2-hr cycle.

Pressure-Jet fluid, electrically heated in pressure-jet unit, is atomized into main steam line beyond boiler at high temperature and adjusted to system pressure. Steam entrained with the atomized fluid carries it to all parts of the system—radiator, trap, return line and all steam-operated equipment. Existing scale, oil sludge, rust, and other products of corrosion are dissolved into minute particles and held in suspension, flowing off with the condensate. Alkaline and *Pressure-Jet* fluid is noncaustic and will not injure ferrous or nonferrous metals, packings or gaskets. It neutralizes the acidity caused by oxygen and carbon dioxide, preventing the formation of carbonic acid by maintaining an alkaline pH.

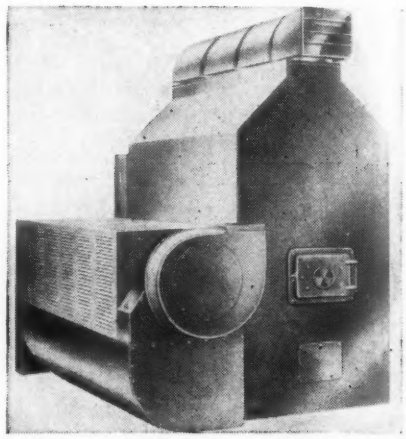
Pressure-Jet fluid acts as a neutral agent to any boiler compound or industrial boiler-water treatment that may be in use. Unit operates either on 110- or 220-v ac or dc. **Pressure-Jet Systems, Inc, 333 W Reservoir Ave, Milwaukee 12, Wis.**

High-Pressure Valves E502

VALVE LINE for the high pressure and temperature field features internal contouring for low-pressure loss. Gate valve series has welded-in guide ribs to eliminate wedge drag on seating faces. *Impactor* handwheel makes opening and closing easier. Pressure-seal bonnet nonreturn valve has closure indicator and flow-directional guiding. **Edward Valves Inc, East Chicago, Ind.**

Chemical Gage E503

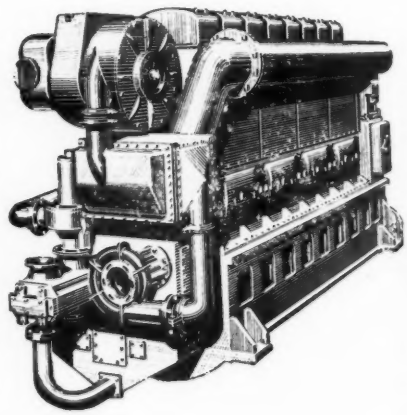
FEATURE OF THIS CHEMICAL GAGE is a *Teflon* diaphragm that resists practically all corrosive chemicals. Using *Teflon* instead of metal for the diaphragm makes the gage adaptable for vacuum as well as pressures up to 1600 psi and gage temperatures of 300 F. Removable bottom part and diaphragm ring are supplied in cast iron, bronze, steel, iron and monel. Unit is particularly suited to chemicals and viscous liquids that corrode or clog an ordinary bourdon tube. **Helicoid Gage Div, American Chain & Cable Co, Bridgeport, Conn.**



Space Heater E504

WARM-AIR coal-fired space heater uses a stainless-steel combustion chamber. Model is available in two capacities, 1,250,000 and 1,500,000 Btu per hr. Fuel consumption for the smaller size is about 133 lb per hr of 12,500-Btu-per-lb coal.

Air to be heated enters at the base, passes over economizer tubes and the combustion chamber to discharge through overhead nozzles. **Dravo Corp, Fifth and Liberty Ave, Pittsburgh 22, Pa.**



Diesel Engine E505

HAMILTON 9x12-IN. 4-CYCLE DIESEL is available in 6- and 8-cylinder combinations, either naturally aspirated or supercharged for ratings up to 1200 hp. Supercharged designs feature relatively high charging pressures and intercooling, to yield high specific output. New engine is suitable for railroad motive power, generator drive,

Use convenient reply cards on page 202a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.

Everything in power piping ...on One Order to Crane

Take This Turbine Piping, for example. Every item in the system—valves, fittings, accessories and pipe—is from Crane, the world's leading supplier of industrial piping. Whether it's piping for power, process, or general service installations, there's no need to search further than the complete Crane line. Everything's in **One Catalog**—an unequalled selection of brass, iron, steel and alloy materials. **One Order** to your local Crane Branch covers all equipment needed for the job.

Complete selection and availability are not the only advantages in dealing with Crane, however. To standardize on this **One Source of Supply** is to simplify every piping procedure, from design to erection to maintenance work. **One Responsibility** for all materials helps you get better installations, avoids needless delays. And in every item from Crane, **High Quality** is your best assurance of dependable performance from every part of your piping systems.

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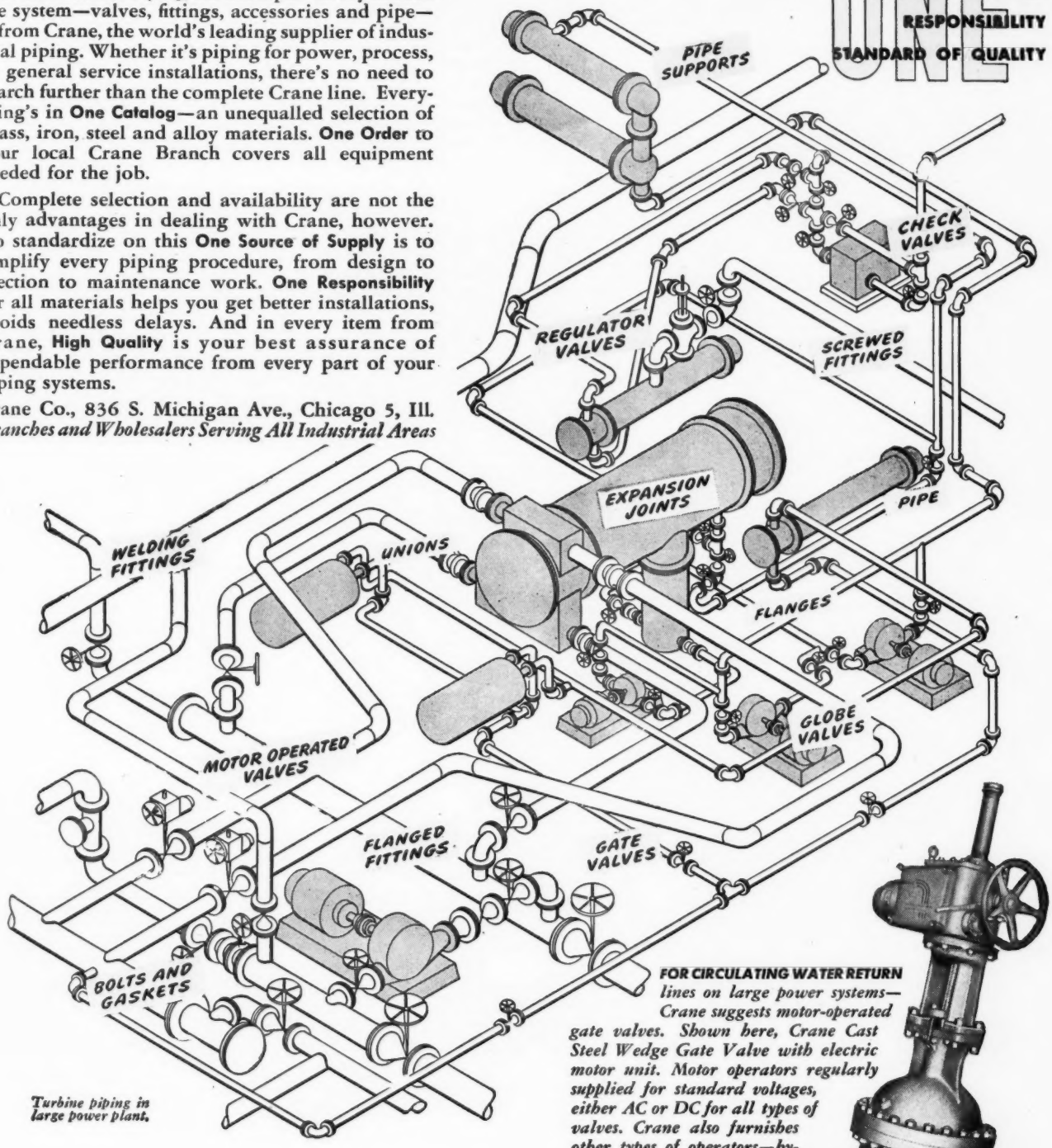
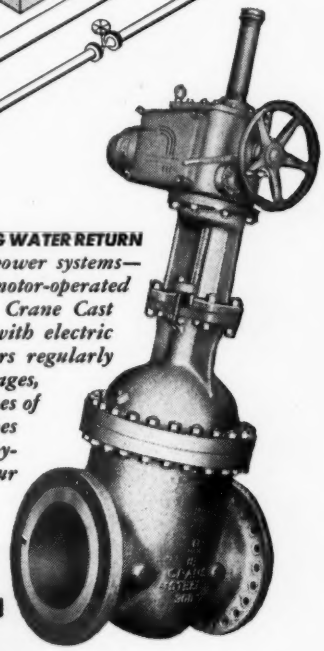


Turbine piping in large power plant.



FOR CIRCULATING WATER RETURN *lines on large power systems—Crane suggests motor-operated gate valves. Shown here, Crane Cast Steel Wedge Gate Valve with electric motor unit. Motor operators regularly supplied for standard voltages, either AC or DC for all types of valves. Crane also furnishes other types of operators—hydraulic, air, etc. See your Crane Catalog.*

EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

CRANE

FOR EVERY PIPING SYSTEM

mechanical-power takeoff, and marine propulsion.

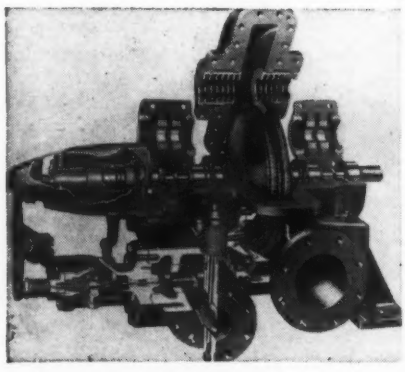
As shown, design is marked by full enclosure. Cylinder heads are cast of *Meehanite*, cylinder block is welded steel, furnace stress-relieved, and liners are wear-resisting iron. Pistons are forged of aluminum and crankshaft of alloy steel. Bearings are precision type. Jumpers between head and block are claimed to prevent leaks into the combustion space; cooling water passes around liner over entire area of piston-ring travel.

Intake and exhaust valves are all same size; valve gear is arranged so it doesn't have to be removed for cylinder-head tightening. Rods can be taken out without removing cylinder liners. All working parts are readily accessible through crankpit covers.

Over-all height is 6 ft 7¼ in., width 4 ft 3½ in., and length 11 ft 2¾ in. for 6 cylinders and 13 ft 5¼ in. for 8 cylinders. **Hooven, Owens, Rentschler Co Div, Lima-Hamilton Corp, Hamilton, Ohio.**

Oil-Well Motor E506

A 3-PHASE, squirrel-cage *Life-Line* induction motor is provided with self-sealed, prelubricated ball bearings offering protective lubrication for five years or longer without repacking. Type *CSP* motor is available for 60 cycles, 3 phases, 220-440 v, 900-1800 rpm, from ½ to 15 hp. **Westinghouse Electric Corp, P O Box 868, Pittsburgh 30, Pa.**



All-Weather Turbine E507

NEW ALL-WEATHER general-purpose turbine *Typee* for driving industrial pumps, fans, blowers, paper machinery and small generators is available in 16-, 20- and 25-in. wheel sizes to develop 5 to 1500 hp with steam up to 600 psig, 750 F, and speeds from 1000 to 7000 rpm. With heavy-duty parts turbine can use 1500-psig 950-F steam. Many parts are interchangeable between wheel sizes.

Combination felt and labyrinth bearing seals protect lubricating system from contamination by heavy rain and abrasive dust. Corrosion-resistant materials are used throughout.

An overspeed trip simultaneously controls governor valve and a heavy butterfly valve. An improved free-expansion center-line support transmits pipeline reaction to the foundation. Entire governor assembly mounted on shaft end protected by casing can be replaced without disturbing shaft. Governor is interchangeable between wheel sizes. Special wide-speed-range governors are available. **Westinghouse Electric Corp, P O Box 868, Pittsburgh 30, Pa.**

Overfire-Jet Control E508

A LIGHT BEAM projected across a boiler or furnace flue shines on a photo tube that measures smoke density. When this density increases beyond a predetermined amount, a red warning light flashes and a timer relay circuit closes. This starts the overfire jets.

Light source and eye box come in an aluminum, dust-tight construction. Lens are sealed and covers gasketed. A tripod support on the light source permits adjusting light-beam direction. **Brooke Engrg. Co, 4517 Wayne Ave, Philadelphia 44, Pa.**

Shielded-Arc Electrodes E509

TUBULAR-TYPE, shielded arc electrodes, the manufacturer says, give a higher consistency to the deposited alloy. *Faceweld* No. 1 deposits a chromium-carbide-alloy surface for hard-facing plain carbon, low alloy or manganese steel exposed to impact. Single-layer deposits have a hardness of 40 to 52 Rockwell C.

Faceweld No. 12 is the same general type but its service is on surfaces withstanding extreme abrasion as well as some impact. Single-layer deposits have a hardness of 45 to 55 Rockwell C but are not as tough as those from *Faceweld* No. 1. **Lincoln Electric Co, Cleveland 1, Ohio.**

Synchronizing System E510

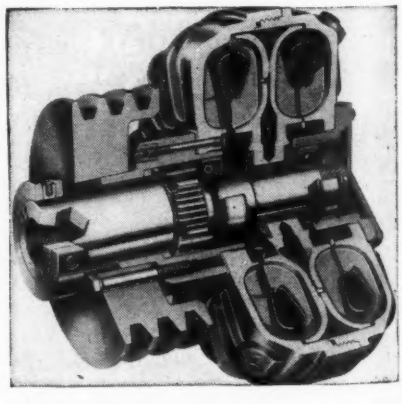
SYNCHRONIZER AND PHASE CONTROLLER is designed to (1) provide automatic and continuous synchronization of rotative speeds of any number of independent engines and (2) hold their crankshafts in any desired phase relation regardless of relative changes in load. These control effects are obtained by use of a differential synchronizer. It operates through an air-servo system connected to the fuel-valve linkage of each engine being controlled.

Device eliminates sympathetic vibrations and exhaust beat often produced by unsynchronized engines and minimizes effect of massive rotating unbalances by holding them out of phase so they tend to neutralize each other. For two or three engines, as in boats or locomotives, one engine is used as a speed reference; where several engines are involved a speed reference such as a synchronous motor may be used.

Rotative speed and phase position of engine being controlled is picked up by flexible shaft or Selsyn motor. Air output from synchronizer controller is piped back to an air motor attached directly to the engine's fuel control. The air servo operates from any convenient source reduced to 20 psi. **Synchro-Master, Seneca Falls, N. Y.**

Boiler-Return E511

PACKAGE BOILER-RETURN UNITS contain a turbine-type pump in single-stage construction. Type *XA*, available in different sizes for boilers from 35 to 700 lb of steam per hr and up to 100 psi, comes equipped with an automatic makeup valve and a 20-gal tank. **Roy E Roth Co, Rock Island, Ill.**

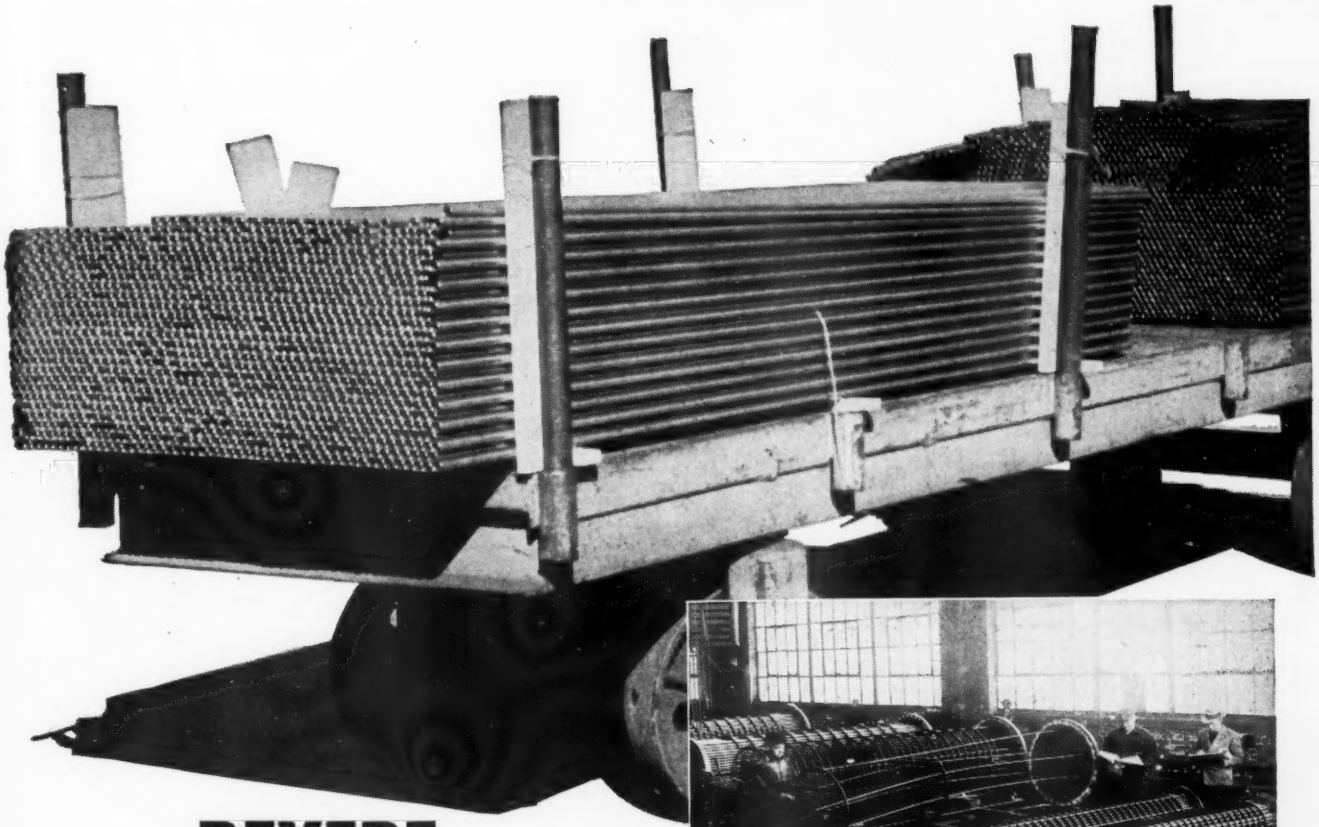


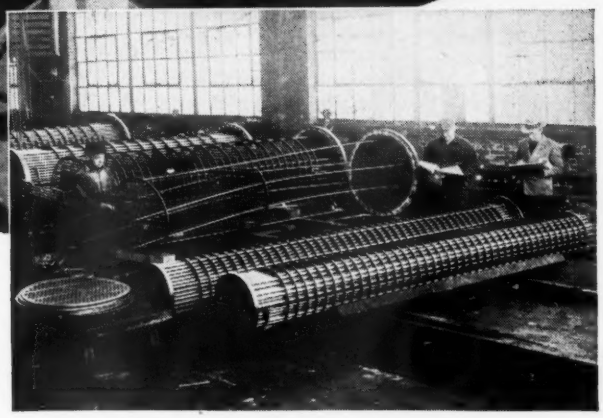
Hydro-Sheave Drive E512

A SMALL HYDRAULIC COUPLING with a V-belt sheave is the basis of a hydraulic-conversion unit for small electric motors and internal-combustion engines in the ¾- to 25-hp range. Oil is the power-transmission medium. Incoming power from the electric motor or internal-combustion engine drives the hydraulic coupling's inner mem-

Use convenient reply cards on page 202a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.

MEETING SPECIAL CONDITIONS





REVERE

REVALON and CUPRO-NICKEL

Because each condenser and heat exchanger presents its own special combination of conditions, no blanket recommendations for condenser tube alloys are possible. However, this much can be stated authoritatively: there are three Revere Metals which deserve special consideration in cases of limited or unsatisfactory tube life. Here they are:

Cupro-Nickel, 30%. Withstands high operating temperatures. A tenacious surface film forms on this metal, which resists impingement attack and erosion, salt water, and waters containing organic material. Widely used in marine and seaboard installations, the tropics and subtropics.

Cupro-Nickel, 20%. Similar to Cupro-Nickel, 30%, but lower in price and somewhat less resistant to certain types of corrosion.

Revalon (Aluminum Brass). This Revere Metal contains a small proportion of aluminum, which gives it a long life in applications where water velocities are high or water is saline. The film formed on this tube is tenacious and self-healing, rendering it highly resistant to impingement attack.

Which of these types to select, or which of the five other types of Revere Condenser Tubes should be chosen, depends on individual conditions. The Revere Technical Advisory Service will gladly collaborate with you in arriving at a decision as to the most economical tubes for your plant.

REVERE

COPPER AND BRASS INCORPORATED

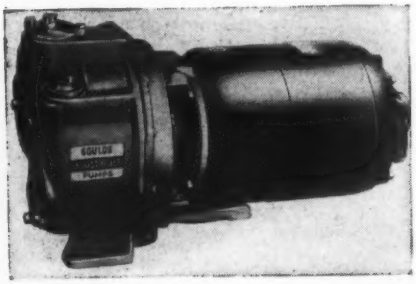
Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N.Y.—Sales Offices in Principal Cities, Distributors Everywhere.

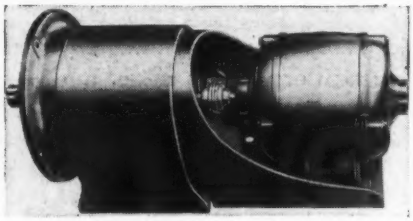
NEW EQUIPMENT CONTINUED

ber, whose blades throw a continuous stream of oil against the vanes of the coupling's outer member or housing. Rotation of the housing with its sheave or sprocket provides a steady power flow to the driven machine. Fluid in the coupling absorbs sudden shocks or overloads from the driven equipment which never reach driving unit. Among its many applications are cranes, hoists, conveyors, elevators, winches, fans, blowers, compressors and other equipment. **Twin Disc Clutch Co, Rockford, Ill.**



Jet Pump E513

A HIGH-PRESSURE, low-capacity pump for industry combines a centrifugal and ejector pump into a compact unit. Industri-Jet pump is good for pressures up to 190 psi and capacities up to 35 gpm. It is designed to handle hot or cold water, alcohol, kerosene, carbon tetrachloride and similar liquids. Pump may be used for general water supply, condensate return, spraying, filter-press service, booster applications and many other services. It is self-priming and cannot vapor lock. Mechanical seal is self adjusting for wear and requires no lubrication. **Goulds Pumps, Inc, Seneca Falls, N. Y.**



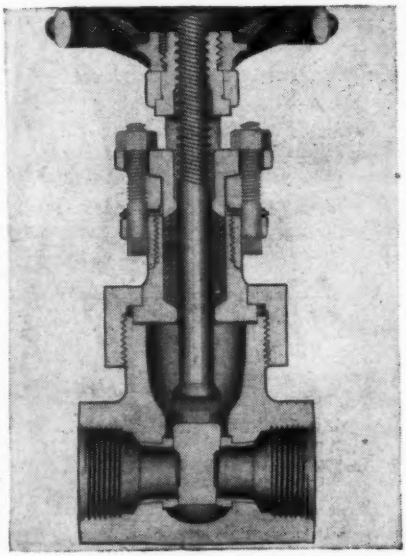
All-Steel Motoreducer E514

COMBINING AN ELECTRIC MOTOR and gear into a single unit, this all-steel motoreducer is lighter but stronger and more rigid than conventional units with cast-iron frames. Housing has dirt and moistureproof seals to protect gear and bearing lubricants against contamination by dirt and moisture. For a given rating, shaft diameters have been increased to provide greater torsional strength and increase overhung-load capacity. Complete line includes horizontal and vertical units in both integral and all motor types for floor, wall or ceiling mounting. Units are suitable for driving a wide range of industrial equipment. **Falk Corp, 3001 W Canal St, Milwaukee 8, Wis.**

Arc Welders E515

TWO ARC-WELDING MACHINES, one ac and the other dc, have just been released by the manufacturer. Ac unit features a built-in power-factor corrector, fingertip stepless current control, forced fan ventilation, wide current range, moderate open-circuit voltage operation. Transformer-type units are available in capacity of 150, 200, 300, 400, 500 amp.

Dc design has a one-dial control panel carrying a series of well-marked outlets, each one for an electrode of different diameter. Motor-driven dc units are available in 150, 200, 300, 400 amp capacities in both the new 3600-rpm model and conventional 1750-rpm type. **Metal & Thermit Corp, 120 Broadway, New York 5, N. Y.**



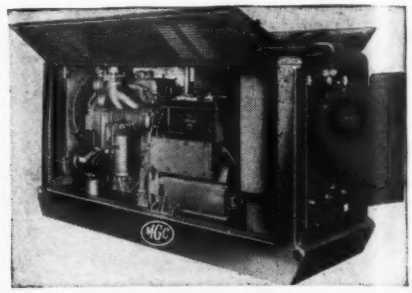
Steel Gate Valves E516

UNION-BONNET, 600-psi cast-steel gate valves are designated No. 3602*XW* and 2602*X* to replace the 3606*XW* and 3606*X* models that are being discontinued. Valves are available in sizes ¼ through 2 in. with screwed ends and two kinds of trim: 3602*XW* has *Exelloy* seats and hardened stainless-steel disk; 3602*X* has seats and disk of *Exelloy*. Joint between bonnet and body is sealed with soft iron gasket.

The *XW* valves are recommended for superheated or saturated steam, hot or cold water, and other nonlubricating and relatively noncorrosive fluids. The *X* valves are recommended for oil and oil vapor at temperatures up to 1000 F. Manufacturer says the *X* valve is not recommended for nonlubricating fluids because *Exelloy-to-Exelloy* seating faces tend to gall. **Crane Co, 836 S Michigan Ave, Chicago 5, Ill.**

Steam Trap E517

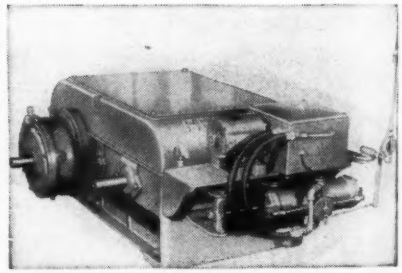
TYPE B inverted-bucket steam trap embodies stainless-steel working parts. Cover plate carries entire working mechanism. A dual-purpose fulcrum and valve-retaining plate gives positive alignment of valve and seat. **O C Keckley Co, 400 W Madison St, Chicago, Ill.**



Diesel Generator Sets E518

FACTORY ASSEMBLED and wired, completely ready to put into service, *MGC* engine-generator sets are available in single- or 3-phase, 50- or 60-cycle ac, in sizes from 5 kw to 60 kw. Each set is self-contained and fully equipped with controls, radiator, fuel tank and weatherproof canopy. Ac generators are revolving-field type with direct-connected exciter and built-in automatic voltage regulators that guarantee terminal voltage within 3% at any load or power factor within generator's rating. Units with compound-wound interpole dc generators, from 5 to 60 kw, may also be supplied.

Up to 25-kw gasoline engines are available to power the generators; from 20 kw up, diesel engines provide the power. These sets are designed for stationary, portable or standby service. **Motor Generator Corp, Hobart Square, Troy, Ohio.**



Variable-Speed Transmission E519

ROTARY-TYPE VALVE applied to Reeves variable-speed transmission permits automatic speed regulation for synchronization of different machines and separate sections of a single machine, maintenance of control tension, uniform peripheral winding speeds, and maintenance of uniform pressure, weight, liquid level, temperature and other variable elements. With few moving

(*Continued on page* 176)

Use convenient reply cards on page 202a to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.

99.99997% (OR BETTER!) Pure Steam

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NALCO Antifoam Chemicals, used as a part of Nalco System Water Treatment, consistently produce steam with only 1 to 3 parts per million solids content — and frequently permit more than double the dissolved solids in the boiler water without danger of carryover!

Truly dry steam is a welcome and valuable protection for turbines, pumps, and the entire steam system ... and Nalco Antifoam Treatment makes a simpler problem of control of boiler water dissolved solids, since it prevents carryover at concentrations far exceeding average practices.

Your Nalco Representative can show you copies of actual steam quality charts that are typical of the *before* and *after* performance of Nalco Antifoam Treatments — *but the best proof is in your own boilers* ... Call or write, today.

1. PURE DISTILLED WATER has no dissolved solids; produces big steam bubbles that burst instantly at surface as shown in Nalco Laboratories test tube boiler.

2. BOILER WATER has high dissolved solids; small bubbles with foaming tendencies cause carryover and impure steam.

3. BOILER WATER WITH NALCO ANTIFOAM Treatment —same water as in Photo No. 2 —now produce large bubbles without foam and pure steam ... the same results as distilled water.

Photos in Nalco Laboratories — unretouched.

... and PRECISION-CONTROLLED BLOWDOWN

● Precision control of boiler blowdown is assured with the Nalco Meterblo Valve... Large, easy-to-read settings ... quick-opening and closing...can be mounted in 16 different positions without special fittings. Now available through your Nalco Representative ... or write direct.

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THE Nalco SYSTEM • Serving Industry through Practical Applied Science

How to plan an EVAPORATIVE COOLER

Another in the series of basic piping layouts prepared by Jenkins Bros.

Evaporative coolers are used extensively to cool fluids for reuse where water rates are high and where the use of water for cooling purposes is restricted by local ordinances. The one illustrated here is typical of those used to cool diesel or gas engine jacket water, oil, or any other warm liquid to be returned to equipment for reuse. The system is also used as an evaporative condenser of gases in gasoline refineries and in air conditioning cycles.

The fluid to be cooled is pumped through coils in the cooler by a circulating pump. Cooling water is sprayed over the coils and a fan speeds up its evaporation. The spray that evaporates picks up heat from the remainder of the spray water and from the liquid in the coils.

The spray water then drains off the outside of the coil into a basin and returns to the spray nozzles where the cycle is repeated. A float in the basin operates a valve in a make-up water line to maintain a fixed level within the basin.

If it is necessary to regulate the temperature of the liquid returning to the equipment, a thermostatically-controlled bypass line is provided. This allows the warm fluid to be mixed with the cooled fluid—by three-way mixing valve or by the hookup as shown—before going into the cooler. When close temperature control of the returning cooled liquid is not necessary, the bypass line with valves F and G can be eliminated.

Jenkins PRACTICAL PIPING LAYOUTS

Illustrating the proved 3-point formula for trouble-free, time-defying hookups

A Use the right type valve for the service.
B Place valves correctly in the line.
C Choose Jenkins Valves for lifetime economy.

41

Fig. 92
Regrinding
BRONZE SWING CHECK VALVE
125 lbs. Steam 250 lbs. O.W.G.

Several types and pressure ranges of Jenkins Valves, other than those shown, can be used for this type of layout, according to the factors involved. Consultation with accredited piping engineers and contractors is recommended when adapting these suggestions to your own requirements, or when planning any major piping installations.

Copies of Layout No. 41 will be furnished on request. Just fill out and mail the coupon.

Fig. 92, the Bronze Swing Check Valve recommended in this layout, is exceptionally serviceable for the non-return control of steam up to pressures of 125 lbs., and non-shock cold oil, water, and gas up to 250 lbs. It is particularly suitable for condensate and return lines, as well as for feed and oil line service—but is not recommended where flow pulsates violently. The high tensile bronze disc is carefully machined to a smooth, tight-fitting finish, and can be reground easily without removing the valve from the line.

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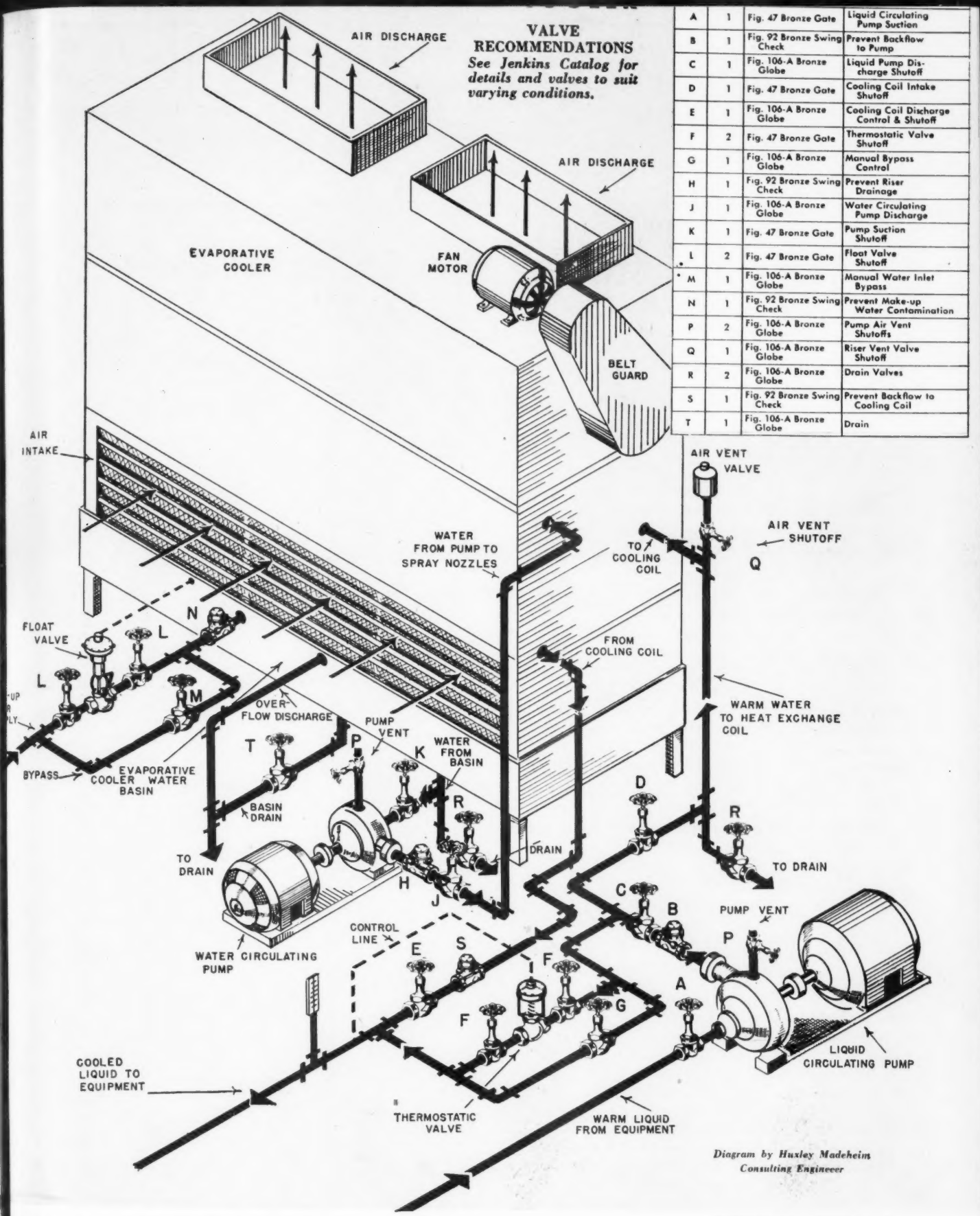

VALVE RECOMMENDATIONS

See Jenkins Catalog for details and valves to suit varying conditions.

A	1	Fig. 47 Bronze Gate	Liquid Circulating Pump Suction
B	1	Fig. 92 Bronze Swing Check	Prevent Backflow to Pump
C	1	Fig. 106-A Bronze Globe	Liquid Pump Discharge Shutoff
D	1	Fig. 47 Bronze Gate	Cooling Coil Intake Shutoff
E	1	Fig. 106-A Bronze Globe	Cooling Coil Discharge Control & Shutoff
F	2	Fig. 47 Bronze Gate	Thermostatic Valve Shutoff
G	1	Fig. 106-A Bronze Globe	Manual Bypass Control
H	1	Fig. 92 Bronze Swing Check	Prevent Riser Drainage
J	1	Fig. 106-A Bronze Globe	Water Circulating Pump Discharge
K	1	Fig. 47 Bronze Gate	Pump Suction Shutoff
L	2	Fig. 47 Bronze Gate	Float Valve Shutoff
M	1	Fig. 106-A Bronze Globe	Manual Water Inlet Bypass
N	1	Fig. 92 Bronze Swing Check	Prevent Make-up Water Contamination
P	2	Fig. 106-A Bronze Globe	Pump Air Vent Shutoffs
Q	1	Fig. 106-A Bronze Globe	Riser Vent Valve Shutoff
R	2	Fig. 106-A Bronze Globe	Drain Valves
S	1	Fig. 92 Bronze Swing Check	Prevent Backflow to Cooling Coil
T	1	Fig. 106-A Bronze Globe	Drain

Diagram by Huxley Madeheim
Consulting Engineeer

VALVES

125 TO 600 LBS. STEAM PRESSURE

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Number 197

Water Conditioning With Sodium Sulphite

► IDEALLY, to rid feedwater of dissolved oxygen it need only be boiled but, actually, it proves safer to use a reagent in addition, to scavenge whatever amounts may remain or be absorbed after boiling. Sodium sulphite proves an effective chemical for this purpose. It works according to the reaction:

$$O_2 + 2Na_2SO_3 = 2Na_2SO_4$$

An excess of sulphite should be maintained above this theoretical requirement to insure complete chemical combination with oxygen.

As concentrations of all impurities in the boiler water are affected by blowdown, it is necessary to consider the blowdown rate in calculating amount of chemical required. Amount of chemically pure sodium sulphite needed to maintain the recommended excess is given by:

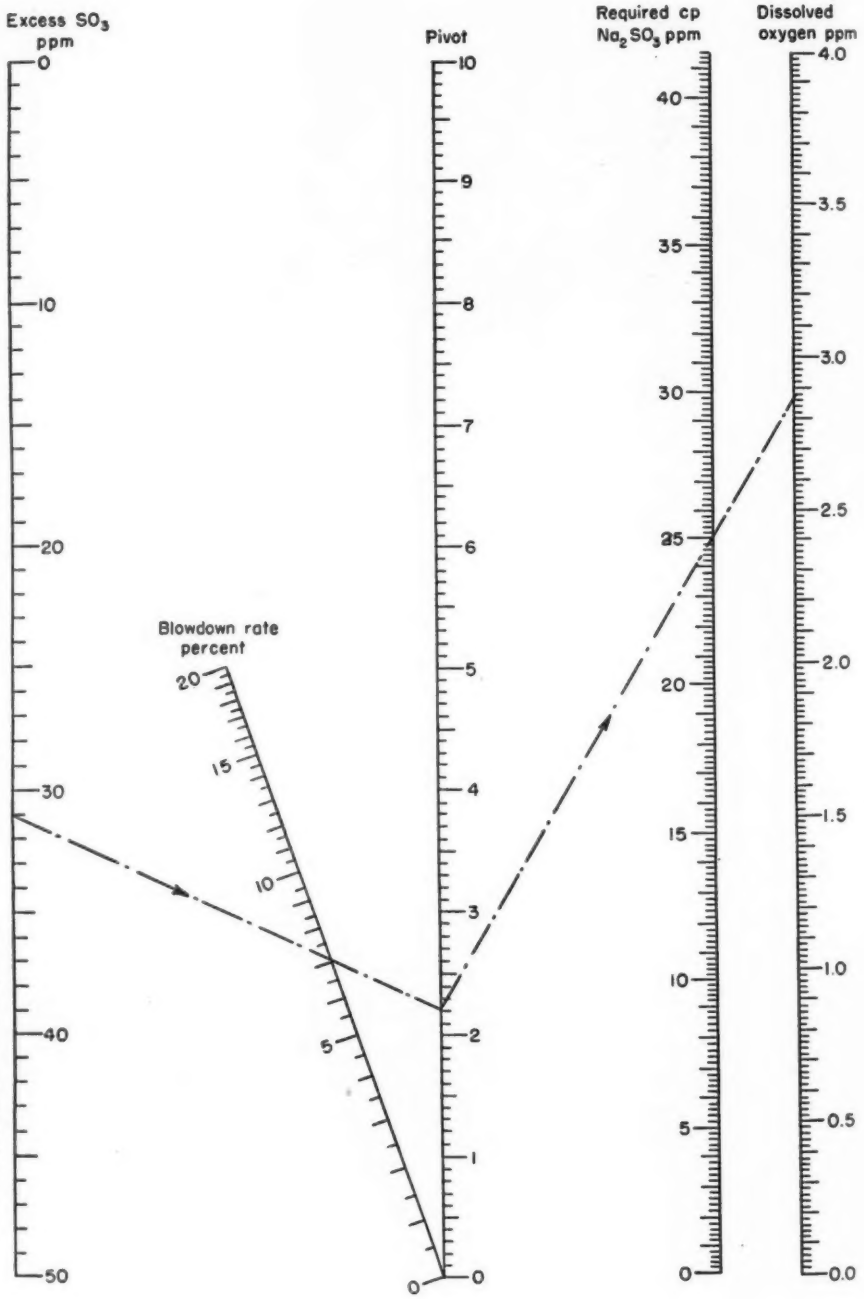
$$\text{ppm } Na_2SO_3 = 0.01 \text{ ppm excess } Na_2SO_3 \times \text{blowdown rate in } \%$$

The amount needed to unite with oxygen theoretically is:

$$\text{ppm } Na_2SO_3 = \text{ppm } O_2 \times \frac{\text{equivalent wt sodium sulphite}}{\text{equivalent wt oxygen}} = 7.875 \text{ ppm } O_2$$

The nomogram facilitates the making of these calculations for conditions of low oxygen content. Connect the value of recommended excess and blowdown rate and produce to the pivot line. Then connect this point with the value of dissolved oxygen. The result gives the chemically pure sodium sulphite dosage in ppm. To convert to lb per 1000 US gallons divide by 120.

BY JOHN F HYAM *Sarnia, Ontario*



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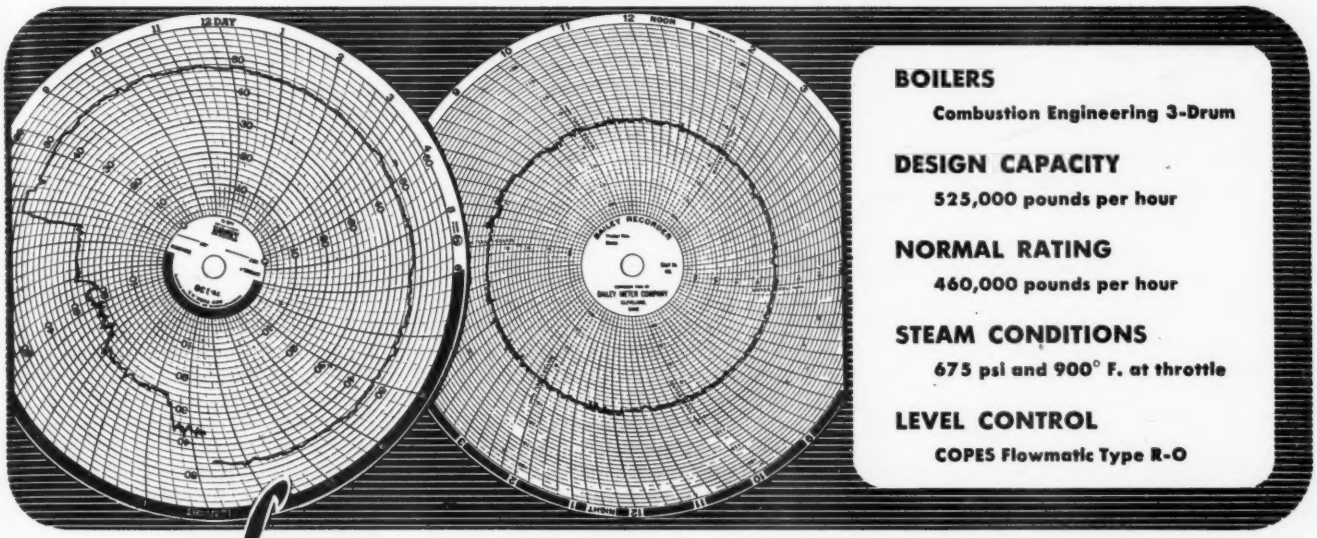
SUDDEN CHANGES IN LOAD



BOILERS
Combustion Engineering 3-Drum

DESIGN CAPACITY
525,000 pounds per hour

NORMAL RATING
460,000 pounds per hour

STEAM CONDITIONS
675 psi and 900° F. at throttle

LEVEL CONTROL
COPES Flowmatic Type R-O

from **460,000 down to 320,000 pounds per hour in 15 minutes . . . 280,000 up to 400,000 pounds an hour in another 15 minutes . . . and level held closely . . .**

No matter how rapidly or widely your boiler load changes, you can be sure of a stable water level in the drum if you depend on COPES Flowmatic for boiler feed control. Users also say adjustments and maintenance are easy for the plant personnel.

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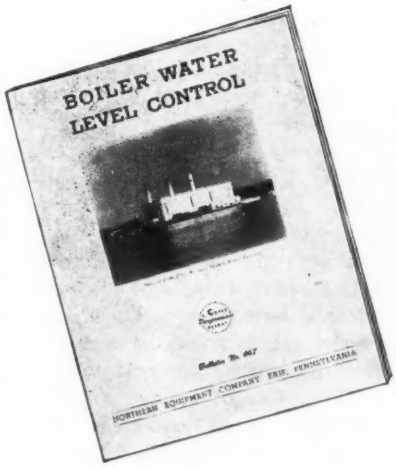
1281 GROVE DRIVE, ERIE, PENNSYLVANIA
BRANCH PLANTS in Canada, England, France and Austria
Representatives Everywhere



Charts above are from Performance Report, Bulletin 467. Write for your copy today.

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TECHNICAL BRIEFS

ENGINEERING DEVELOPMENTS HERE AND ABROAD DIGESTED FOR BUSY POWER MEN

REVIEWED IN THIS ISSUE

FEEDWATER

Some Practical Aspects of Deionization With Ion-Exchange Resins

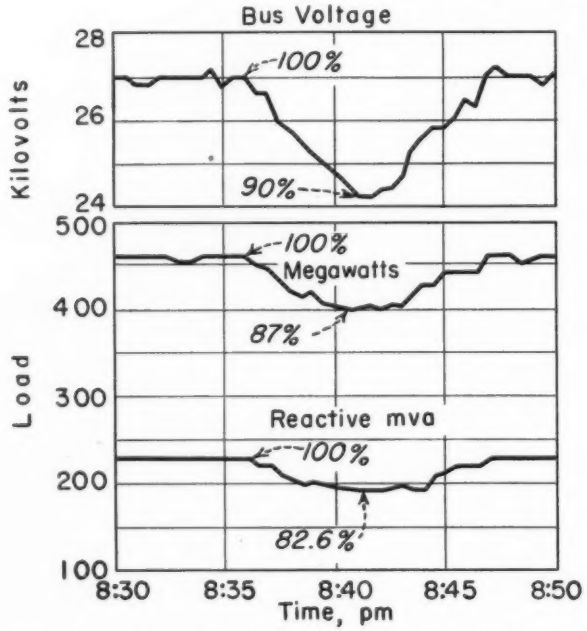
STATION CONTROL, COSTS

Emergency Control of System Load
Steam-Station Cost Survey in U. S. A.

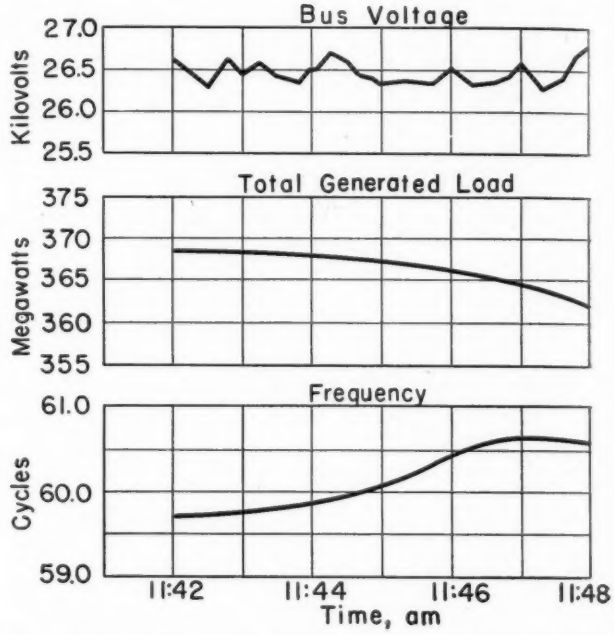
STEAM EQUIPMENT

Superheater Tube Failures
Repairing the Blades of Turbines

Directions for ordering papers are given on page 154



HOLDING FREQUENCY CONSTANT, load reduced by lowering voltage. About 68% system load was lighting and 32% power



VOLTAGE HELD CONSTANT; frequency was varied to reduce system load, estimated as 39% lighting and 61% miscellaneous

FEEDWATER

SOME PRACTICAL ASPECTS OF DEIONIZATION, *by Joseph Thompson & Francis X McGarvey, The Resinous Products & Chemical Co.* Introduction of this paper states: "In the application of ion-exchange resins to plant scale processes, it is essential that the equipment be planned and operated to utilize these materials to greatest advantage. Because of our close cooperation with engineering organizations throughout the past seven years, many individual factors have been brought to our attention which very markedly affect good unit operation and have, in some instances, pointed the way for further investigation on our part. Some of the incidents to be related hereafter are based upon facts, so elementary in nature to those devoting much of their time to the ion-exchange process, that very often difficulty is encountered by the operating engineer by failing to call such points to his attention."

Following this down-to-earth line of reasoning the authors point out the various pitfalls that can upset the performance of an ion exchanger and explain how certain factors such as backwashing, regeneration, bumping and leakage affect the over-all performance of an ion exchanger. Presented at the Engineers' Society of Western Pennsylvania Eighth Annual Water Conference, Nov 1947. *Copies available from The Resinous Products & Chemical Co, 222 W Washington Square, Philadelphia, Pa.*

STATION COSTS

EMERGENCY CONTROL OF SYSTEM LOAD, *By J M Comly and J E McCormack, The Consolidated Edison Co of New York; G B Kelley and T W Schroeder, United Light and Railway Service Co, Iowa; H W Phillips, Pennsylvania-New Jersey Interconnection, Philadelphia, Pa.* The authors' aim in this joint paper is to point out some of the possible effects of attempting to reduce system load by dropping frequency and voltage.

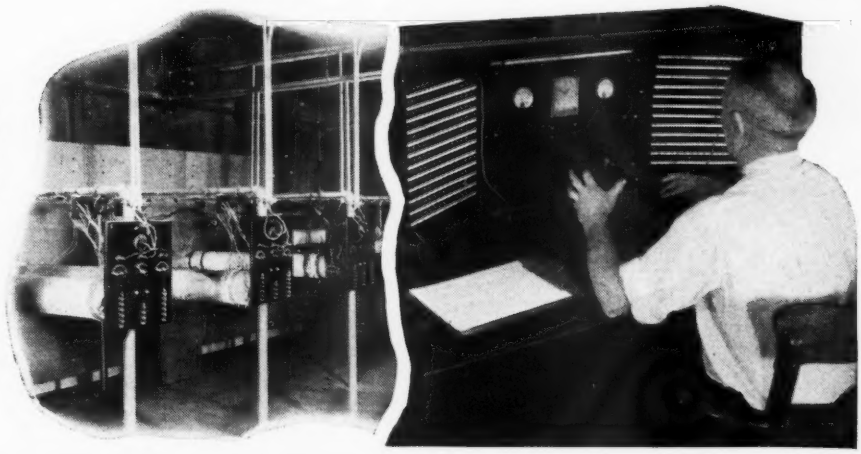
Generally speaking, reduced frequency results in slower operation of rotating equipment and consequently less work is done, diagram at right. On the other hand, a reduction in voltage generally lowers lighting intensity and cuts other resistive-type power loads but has less effect on motor loads, diagram at left. Field tests on a particular system should be made before conclusions can be drawn.

Experience shows voltage reduction cuts reactive as well as kilowatt load, while lowering the frequency may increase reactive load at a time when reactive capacity and real power are at a limit. Use of voltage or frequency reduction should not be considered on a permanent basis but only as a means to meet unusual emergency conditions.

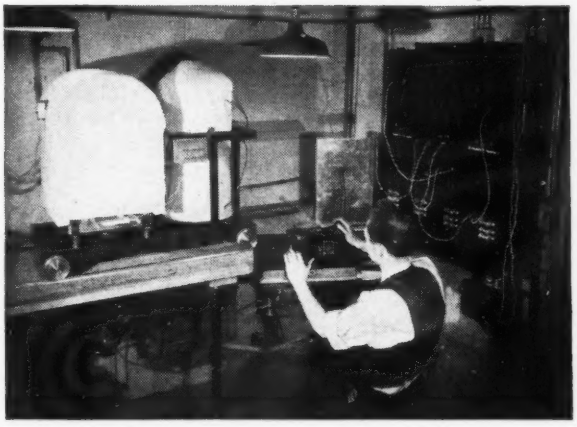
From tests made on the Pennsylvania-New Jersey Interconnection, it was

Facts about J-M Insulations Subject: RESEARCH

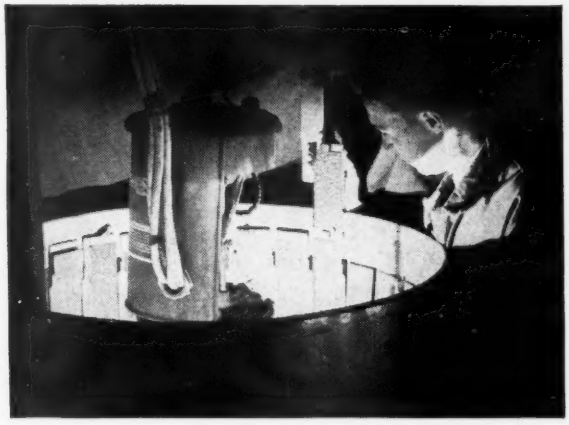
They measure heat to save millions for industry



ACCURATE HEAT FLOW MEASUREMENTS are being made by this man to test the thermal conductivity of pipe insulation. He can make readings within ⅓ of 1 degree F. at 800 different points on this apparatus in the Johns-Manville Research Laboratory—the largest, best equipped and most modern thermal testing laboratory in the world.



THIS "HEAT-EYE" UNIT was developed in the Johns-Manville Laboratory to measure the thermal reflectivity of various insulating materials. Heat flow, in all its forms, has been carefully studied by Johns-Manville engineers since the turn of the century.



MAN-MADE WEATHER in this machine tests the ability of insulation jackets and casings to withstand exposure to sunshine, rain and freezing temperatures. The trend toward "outdoor" equipment in many industries makes the findings of this research invaluable.

● Johns-Manville Research is the proving ground for industry's insulation requirements—a place where the economic value of insulating materials is determined with mathematical accuracy.

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For complete details and answers to your special insulation problems, write Johns-Manville, Box 290, New York 16, New York.

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found a 1% reduction in voltage in general is followed by a 1% cut in load. Generally speaking, voltage may be reduced as much as 7½% with satisfactory results. Authors outline a procedure for reducing voltage and frequency under emergency conditions.

Tests conducted by the Kansas City Light and Power Co, serving the metropolitan area of Kansas City, Mo., show it is possible to lower system primary voltage up to 5%, decreasing frequency 1½% at the same time.

AIEE technical paper 48-267, presented at the AIEE Midwest general meeting, Milwaukee, Wis., Oct 18-22, 1948.

To Obtain Complete Text

Material in these briefs comes from one of two sources unless specifically identified after review of paper.

American Institute of Electrical Engineers, Midwest general meeting, Oct 18-22, 1948, Milwaukee, Wis. Available at AIEE, 29 W 39th St, New York.

American Society of Mechanical Engineers, spring meeting, March 1-4, 1948, New Orleans, La.; fall meeting, Sept. 7-9, 1948, Portland, Ore. Available at ASME, 29 W 39th St, New York.

STEAM STATION COSTS, *by A E Knowlton, Electrical World.* Energy generated in a representative USA central-station power plant shows production costs ranging from as low as 1.5 to as high as 14 mills with an average value of 4.5 mills per net kwhr. Nine years ago this average was about 3 mills.

Average cost of net kwhr at the busbar for plants from 5000 up to 300,000 kw rating in 1947 ran 7.5 mills. With this figure plus the average 4.5 mills, production-cost fixed charges can be set around 3.0 mills on a broad average basis.

One point of considerable interest advanced by the author was the fact that the 1947 load proved so great only one in six plants had a peak below rated capacity. In fact, peaks commonly reached 120 to 130% rated capacity. Plant factor (ratio of actual net output to that obtainable over 8760 hours of full-rated capacity) showed up even more favorably, except for the largest plants, the national, sampled average ran about 70% in 1947.

Survey, with 102 generating stations reporting, indicates a kilowatt of installed capacity has cost as much as $200 and, at one time, as little as $46. This phenomenally low figure comes about from (1) an outdoor installation (2) a highly simplified design built specifically for a very low-cost fuel. General average runs about $90 to $130 for plants operating in 1947, regardless of age of the oldest operating unit.

Progressively larger plants carried at lower costs per unit of rating than smaller ones. Largest plants, even if quite ancient, represent lower costs than middle-sized ones. The latter show up advantageously in over-all costs per net generated kwhr.

Plants of under 60 megawatts, built in 1920-1929 and not since expanded, cost on the average about $150 per kw. Those built in 1930-1934 average about $107, while those in 1935-1939 cost as low as $76. By 1940-1944, unit cost soared to $110, and by 1945-1947 to $135. According to the author this figure of $135 still does not touch the unit cost experienced in the inflation and boom after World War I.

Investment costs for plants of 60-149 megawatt rating, built within the 1920-1929 decade, average about $100 per kw of rated capacity. By 1940-1944 this average fell to $83, but by 1945-1950 came back to about $113. Investment cost regardless of plant vintage indicates that spread in dollar per kw runs much higher for small plants than for large. The largest represent $85 per kw, and the smallest about $120.

Boiler plants constitute the largest component of over-all costs. Structure and improvements for a $100 plant amount to $28, boilers and associated thermal equipment to $36, and turbine-generator to an added $26. All office space, shop, electrical galleries, etc. account for another $10.

Higher boiler pressures and steam temperatures afford better thermal performance. The 1200- to 1600-psi hit below 11,500 Btu per net kwhr; 800- to 1000-psi plants hover near 12,000. The 600- to 700-psi plants reflect about 13,000. Finally, the 200- to 400-psi plants range from about 14,000 to 26,500. July 3, 1948, *Electrical World*, 330 W 42nd St, New York City.

STEAM EQUIPMENT

SUPERHEATER TUBE FAILURES, *by H B Snider and F H Ward, Humble Oil and Refining Co.* Continued failures of end superheater tubes in a 275,000-lb-per-hr 650-psi boiler kept causing unscheduled shutdowns and interruptions to steaming capacity. Upon examination of the ruptured tubes excessive deposits showed up.

A checkup of normal causes for carryover, excess boiler-water alkalinity, high total solids, high water level revealed no abnormal conditions. For this reason decision was made to carry out a fairly comprehensive test of steam leaving the boiler drum and entering the superheater. Standard sampling apparatus and sampling connections were set up to draw from the drum, twelve of the connector tubes between drum and saturated header, saturated superheater header, saturated header drain, and eight end superheater tubes.

Saturated header construction is such that the space through which steam enters the header from the drum connector tubes is less than that in which steam leaves the saturated header through the superheater tubes. This construction forces a lateral flow of steam at the ends of the saturated header. The resulting 90-deg turn precipitates solids to the end of the saturated header where they concentrate. The end superheater tube obtains its steam from this section and overheating of the tube results.

Steam samples indicated a steam quality of 0.60-ppm total solids average produced in the drum. This quality held for the steam entering the saturated header. Since superheater-tube failures from carryover are rare with steam of a quality less than 1 ppm for solids, steam from the drum and the saturated superheater header were felt not to cause these tube failures.

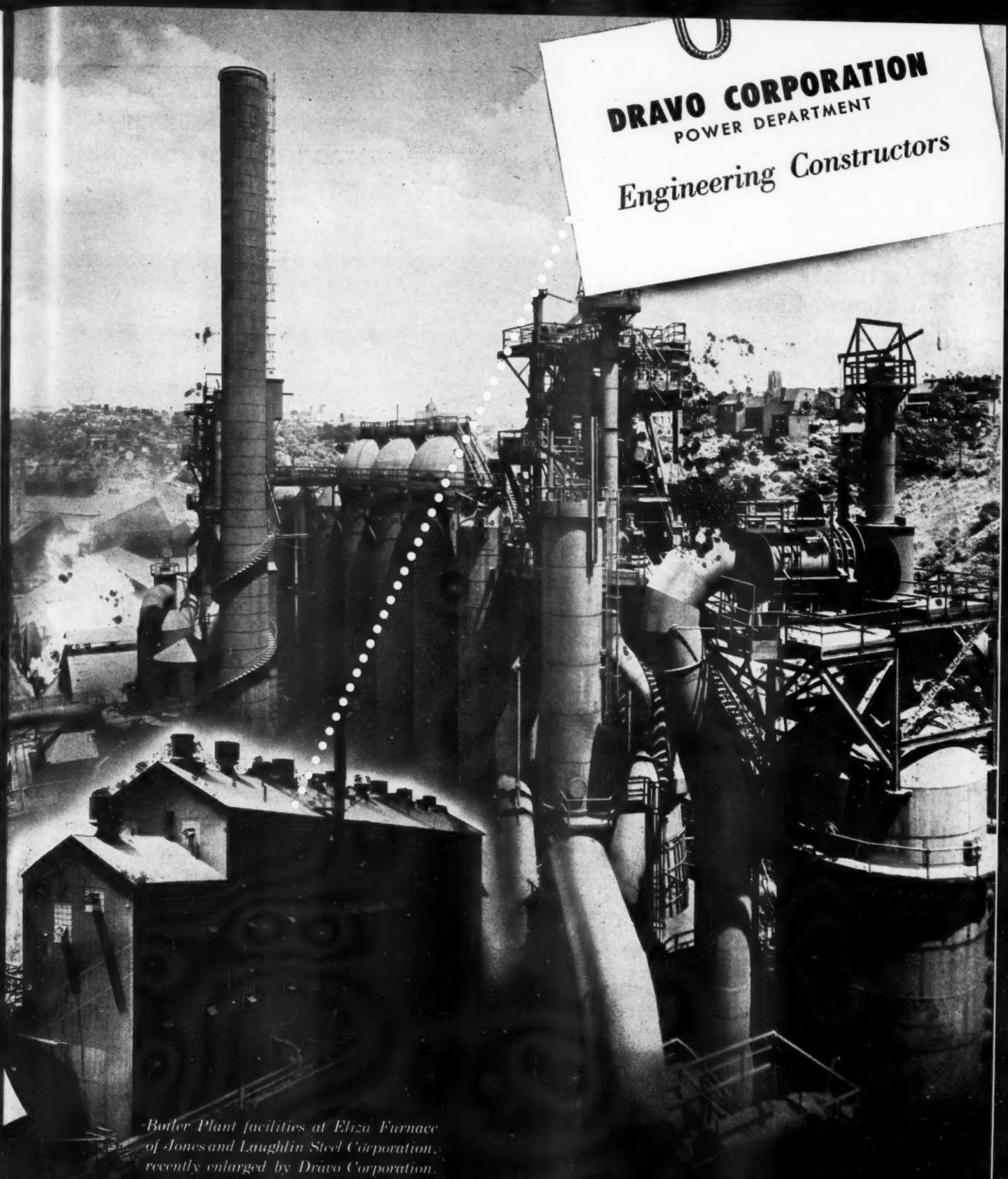
Saturated header steam showed 1.4 ppm, and at this header drain it was 13.35-ppm total solids. All evidence indicated the solid concentration as developing at this end of the saturated header.

Steam samples from the superheater tube ends confirmed this evidence. The end superheater tube contained 3.15-ppm total solids, while samples from the adjacent superheater tubes indicated much less.

To correct this feeding of heavily concentrated solids to the end superheater tube it was decided to add an additional connector tube between saturated header and drum, just opposite the superheater tube next to the end superheater tube. In addition, new drum internals of the same design as the old ones were put in.

When the boiler returned to service, data from sampling points showed a decided improvement in steam quality. From the drum it was 0.30 ppm, and from the saturated superheater header

(*Continued on page* 174)



Boiler Plant facilities at Eliza Furnace of Jones and Laughlin Steel Corporation, recently enlarged by Dravo Corporation.

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Electrical Power Demand Continues Growth Rate

► CONTINUATION OF THE HIGH RATE of growth of electrical power demand in most parts of the United States and a large increase in installation rate of new generating capacity were reported recently by Ernest R Acker, president of Edison Electric Institute, in commenting on results of a survey just completed by a group of power-supply experts representing all sections of the country.

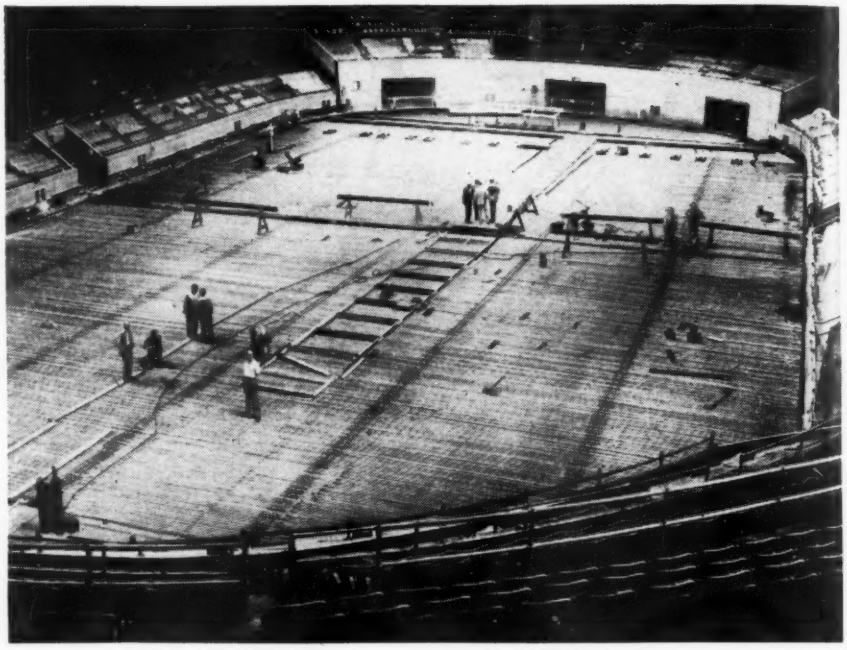
The survey finds that installation of new generating capacity, which in 1947 was 2,000,000 kw, will be 4,750,000 kw in 1948 and 6,700,000 kw in 1949. The 1950 installation schedule is 5,800,000 kw, and the 1951 is 6,060,000 kw. Deliveries of generating equipment are generally being made a little ahead of schedule, although there is some difficulty in getting construction steel, piping and other construction accessories for equipment installation.

Peak Demand Estimate. The survey also finds that currently, with equipment manufacturers working at full capacity and with their output far exceeding all previous records, demand for electricity continues to climb. The new estimate of peak demand for December 1948 is 1% higher than the forecast made by the same group of experts last May. The somewhat higher demand is attributed principally to influence of world conditions on United States business and industrial production.

Reserve generating capacity for the country as a whole during this month is expected to be 4% as compared with a 5% margin in December of last year. President Acker said that reserves will be somewhat less than last winter in a few areas and somewhat greater in others, but generally sufficient to meet the needs for power.

On the evidence of the present survey, power experts estimate that the December 1949 average margin will climb to 8% and that 14%, which is regarded as a normal reserve, will be reached by 1951. However, the validity of these estimates for the future will

(*Continued on page* 200)



New Arena Floor at Madison Square Garden

View of Madison Square Garden arena in New York City shows floor that was laid in record time of four weeks as a result of a technical development in use of threadless pipe fittings to connect 13 miles of concealed refrigeration piping. As the floor has to stand up under rigorous conditions, piping has to take extraordinary weights and vibrations, as well as temperatures varying 10 to 70 F. Some 3000 threadless, black, malleable, 1¼-in. couplings were employed to connect, by silver brazing, 20- and 40-ft lengths of 1¼-in. standard-weight galvanized-wrought-iron pipe. Piping, which withstands hydrostatic tests of 2500 lb and air tests of 300 psi, was laid over original base of floor, which had been covered with two new layers of waterproofed tar paper and one of zinc sheeting before the pipe was put down

COMING EVENTS

Nov 28-Dec 4—American Society of Mechanical Engineers, annual meeting, Pennsylvania and New Yorker Hotels, New York, N. Y. Ernest Hartford, executive assistant secretary, 29 W 39th St, New York 18, N. Y.

Nov 29-Dec 4—18th National Exposition of Power & Mechanical Engineering, Grand Central Palace, New York 17, N. Y. Charles F Roth, manager, Grand Central Palace, New York.

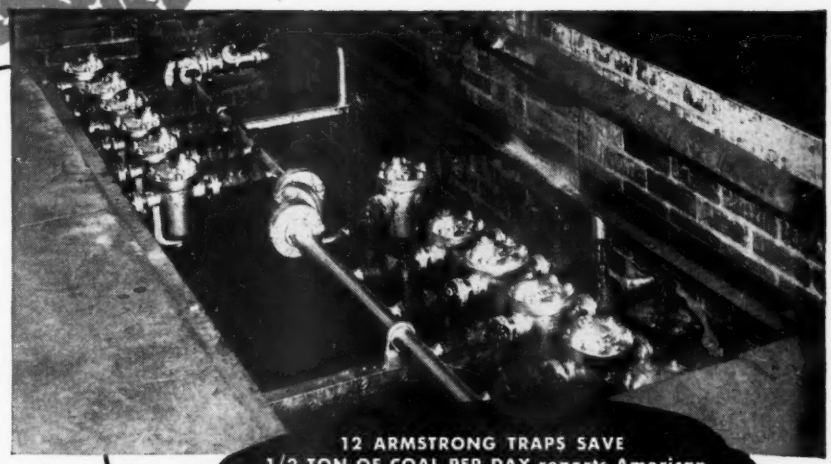
Dec 5-8—American Society of Refrigerating Engineers, meeting, Statler Hotel, Washington, D. C. W S Woodside, 801 Whittaker Bldg, Baltimore, Maryland.

Jan 10-14—Third National Materials Handling Show, jointly sponsored by American Society of Mechanical Engineers and Materials Handling Institute, Convention Hall, Philadelphia, Pa. Banner & Greif, 250 W 57th St., New York 19, N. Y.

Jan 24-28—International Heating & Ventilating Exposition, International Amphitheatre, Chicago, Ill. Charles F. Roth, manager, Grand Central Palace, New York 17, N. Y.

Jan 31-Feb 4—American Institute of Electrical Engineers, winter general meeting, Pennsylvania Hotel, New York, N. Y. H H Henline, secretary, 33 W 39th St, New York 18, N. Y.

Coal Saving gets more important all the time!

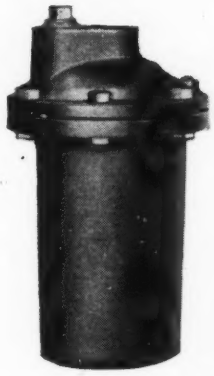


12 ARMSTRONG TRAPS SAVE 1/2 TON OF COAL PER DAY reports American Snuff Company, Clarksville, Tenn., since unit trapping coils in their tobacco drying kilns.

38.5%

FUEL SAVING

Of reports turned in over the past 18 years dealing with steam saving secured by Armstrong Trapping, those that give figures show savings of 13 to 50% with an average of 38.5%.



Left—*Bottom inlet—top outlet series. Available with cast semi-steel (250 psi maximum) or forged steel (2400 psi maximum) bodies and caps. Complete range of sizes.*

Right—*Side inlet—side outlet series. Available in four popular sizes for pressures to 250 psi.*

Armstrong Steam Traps are sold on a basis of "satisfaction or your money back." Trained factory representatives are located in 47 principal cities. Traps are stocked at 147 points.

CONSERVATION of your coal pile is vital these days when you have to read the newspaper each morning to find out how much coal costs and whether you can get any.

Armstrong Steam Traps will help you save coal (or any fuel) for the following reasons:

NO STEAM LOSS—no steam leaks past the Armstrong trap valve, even when there is no condensate load. When steam enters the trap, the bucket floats and closes the valve. Full steam pressure behind the valve holds it closed *tightly.* (The chrome steel valve and seat are hardened, ground and lapped to a precision, steam-tight fit).

NON-PRODUCTIVE RADIATION LOSS MINIMIZED—with Armstrong traps, steam gives up more heat through the steam-consuming unit, less through the supply and return lines. Removal of condensate *and air* as fast as they accumulate assures maximum heat transfer efficiency. Steam flow is faster. Condensate is discharged at steam temperature—no cooling legs, no drainage delay with radiation loss in the line to the trap. Faster heat-up, faster production.

The **ARMSTRONG STEAM TRAP BOOK** will help you select, install and maintain traps for maximum fuel savings. Write for a copy.

ARMSTRONG MACHINE WORKS
806 Maple Street • Three Rivers, Michigan

ARMSTRONG *Inverted Bucket* STEAM TRAPS

Over a Million in Use...For Power...Process...Heating

Christmas Eve In the Wheel Pit

Christmas 1922. A date long past, but one that still sticks in our minds—the repair crew that had to fix an old hydro-electric plant. It wasn't big, but it was important to the little town it served. Without it there would be no lights for Christmas trees and other uses around the home, no street lights—you know what it would mean. True, there was a diesel auxiliary, but it could handle the load only from 10:00 pm till 8:00 am, so repairs had to be made at night, and fast.

The plant, far from town, was surrounded by muddy roads. A light snow was falling, and it was cold. When we shut down at 10:00 pm for repairs to start, the wind came up and with it more snow and cold. The old wooden sluice gates (about 20 ft square) stuck and would not shut. Finally we got them fairly well closed, and packed sacks, mattresses and cottonseed hulls on the upstream side to make them hold pretty well. It was colder than the well-known brass monkey down in that wheel pit, with ice water over ankle-deep.

To get at the bottom step-bearing, coupling bolts had to be taken out, the wheel casing unbolted and hoisted out with the turbine. This bearing was of lignum-vitae wood, shaped like a big collar button and heavy as iron. Before the new one would be ready to put in, it had to be taken to town through the snow and mud and turned down half an inch to fit. It was some job, too, to rouse out a lathe man at midnight.

Finally, all was ready. The foreman sat on the edge of the wheel setting, we of the crew gathered round him. "Let's get this straight," he said. "If anyone drops this bearing he's got to go into the pit after it."

All of us agreed, shivering and shaking. We inched out onto the 60-in. draft-tube top on the three spider arms, and tried to get the bearing into the hole. It was the foreman himself who let it slip, and down it went, into nearly eight feet of water. Sort of white, he looked around. He edged over to the rim of the draft tube, took a deep breath and went under. In a few seconds that seemed like hours he came up. Eight hands grabbed at him and hauled him out. Up the ladder to the stove he went, while the rest of us fitted in the bearing—the only lignum-vitae bearing nearer than Springfield, Ohio.

Lights burned in the town and no one there knew of the Christmas Eve struggle. The boss remembered it, however. He was the only one that didn't get soaking wet. Nevertheless, he spent a week in bed with septic sore throat, possibly caused by arguing with the machinist to come out and turn down the bearing after midnight.

Carlsbad, New Mexico E A Roberts

This is a story of a group of men, power men, who will always recall Christmas and its spirit of sacrifice with a strong sense of personal experience—an experience based on meeting a power interruption without thought of self.

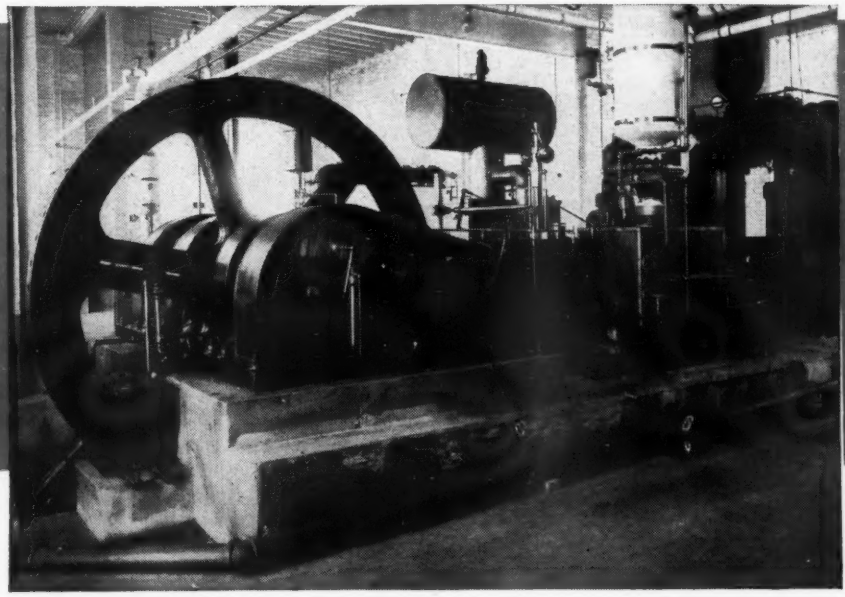
Every power man at one time or another has come up against an equipment breakdown. Years ago it meant loss of lights for a town. Today, a power interruption upsets the entire business and domestic life of a community.

So when such a blow hits a town on Christmas Eve a real power man, like those in this story of other years, still falls to without hesitation. To him Christmas and all it represents—"Peace on Earth, Good Will to Men"—is a living thing. He enjoys hearing and saying "A very Merry Christmas to all."

George Edwards
Engineer

step up STEAM ENGINE EFFICIENCY

Get more power and steam economy with Texaco steam cylinder oils



FOR dependable, full-powered steam engine performance, use the Texaco steam cylinder oil recommended for your particular engine and operating conditions.

Texaco steam cylinder oils atomize completely and cling to cylinder walls. They assure excellent ring seal, smooth valve action, protection against wear. Use them to get maximum efficiency and economy from your engines—whether they're old or new.

Texaco has a complete line of steam cylinder oils, and a Texaco Lubrication Engineer will gladly help you select the one to bring you best results. Just call the nearest of the more than 2300 Texaco Wholesale Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

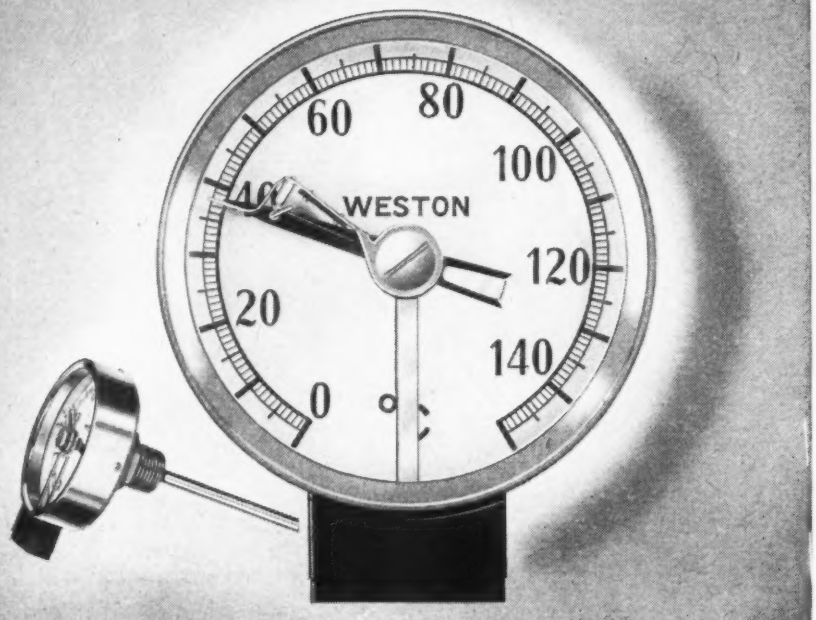
TEXACO Steam Cylinder Oils

FOR EVERY OPERATING CONDITION

Tune in...TEXACO STAR THEATRE presents MILTON BERLE every Wednesday night. METROPOLITAN OPERA broadcasts every Saturday afternoon.

NEW —

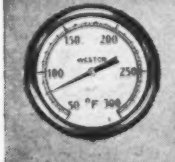
all-metal WESTON *Contact-making* thermometer



This new Weston combines the features of an indicating device with the advantages of an alarm or control instrument. A contact arm, mounted as shown above, is easily set to make contact at any temperature on the scale.

A terminal block on the periphery of the case makes electrical connection easy. The thermometer is all-metal, typically WESTON in ruggedness and reliability, with accuracy of ±1% as an indicating thermometer, and ±1½% as a contact making device. It is supplied in two types—for operation on either increasing or decreasing temperatures.

For complete information see your local WESTON representative or write Weston Electrical Instrument Corporation, 679 Frelinghuysen Avenue, Newark 5, New Jersey.



Industrial Thermometers

MAX-MIN Thermometers

Contact-making Thermometers

WESTON *Thermometers*

type and characteristics of the driven machine. A shock load of a crusher requires more reserve horsepower capacity in the drive than a smoother operating unit like a pump or compressor. When in doubt it is better to overbelt than to underbelt a drive.

Overload Capacity. Characteristics of prime mover and driven machine must be taken into account when determining the necessary overload capacity that a drive should have to give satisfactory service. From these considerations V-belt engineers provide service factors that indicate the overload capacity to add to the nominal driver horsepower in each case. Service factors recommended by the V-belt manufacturer give the horsepower capacity required for the application in question.

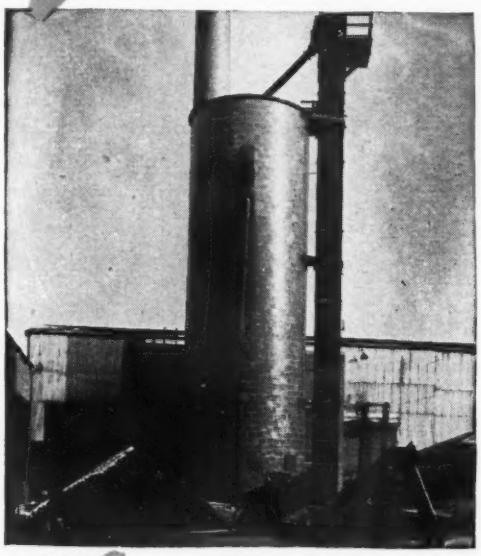
Center Distance. Center distance of a V-belt drive is important. The generally accepted rule is that the ideal center distance is between 1 and 1½ times the diameter of the larger sheave. Use of the shortest centers whenever possible insures use of the shorter pitch length belts. These are not only lower in first cost and for replacement but also in maintenance. A short-center distance, therefore, is important in selecting the most economical drive.

All these points must be considered carefully in engineering a drive. The most economical uses the proper section V-belts so a minimum number provide the total horsepower-transmitting capacity of the drive. Sheave diameters will be large enough to insure good belt lift, yet not so large as to give excessive speed. If one sheave is larger than the other, the lesser arc of contact on the smaller sheave must be taken into account. Center distance will be as short as practicable. Last but not least, the service factor prescribed for the application must determine the number of belts necessary to transmit the total actual horsepower required.

Horsepower. Certain salient facts help in selecting belts and sheaves that go to make up the most economical drive. First is a belt-selection table that most manufacturers publish. This simply recommends the belt section for different speeds with various-sized motors. Based on nominal horsepower, it is a result of experience in figuring thousands of drives. While there may be exceptions its recommendations can practically always be followed. At least it provides a starting point in deter-

HAVE YOU CHECKED YOUR POWER PLANT COSTS LATELY?

Coal elevator feeding internal bunker



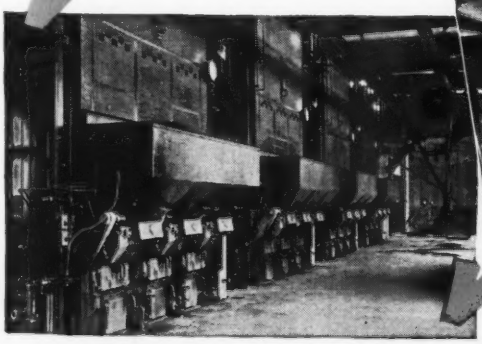
200 Ton Coal Silo

There could be some excessive operating costs hidden in an antiquated or inadequate coal or ash handling system. To be on the safe side, check the many proven time and labor saving advantages offered by

FAIRFIELD
COAL and ASH HANDLING EQUIPMENT

A system of this kind, planned by Fairfield, is designed, built and erected especially to meet the operating and physical requirements of your plant.

Fairfield Engineers, specialists in the planning of Coal and Ash Handling systems, and with many years of practical experience back of them, are at your service. Why not call one in for an analysis of your requirements? Write for Catalog No. 144-A.



Two-Ton motor driven weigh larry serving four boilers.

Chutes from bunker to pulverizers.

Belt conveyor and tripper over suspension bunker.

The FAIRFIELD ENGINEERING COMPANY

BUILDERS OF DEPENDABLE COAL AND ASH HANDLING EQUIPMENT

327 CHICAGO AVE. MARION, OHIO, U. S. A.

YARWAY
IRON
SCREWED-END STRAINER
FLANGED-END STRAINER
Easy
TO SERVICE
• A good strainer protects your equipment and pipelines.
Maintenance men said "give us a strainer with a blow-off cap that comes out easily and makes up tight; a screen that can be put back in place without a lot of fiddling around".
• The easy-to-remove Yarway cap meets these requirements. It has straight (not tapered) thread, machined face and spark-plug-type gasket. Permits easy removal for cleaning. Insures proper screen alignment when replaced in body.
• Screen itself is of high grade woven monel wire, or perforated if desired.
• Body of strainer is iron or steel, cadmium-plated for protection against corrosion and for better appearance.
• Available in six sizes, ½" to 2", for pressures to 600 lbs. Reasonably priced. Hundreds of thousands in use. Stocked and sold by 150 Mill Supply Houses.
• See your dealer or write for Bulletin S-201.
YARNALL-WARING COMPANY
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YARWAY STRAINERS
"Police the Pipelines"

mining the most economical drive units.

Table II is a typical selection table. In some instances alternate belt sections are listed, indicating that either makes a satisfactory drive. But one or the other gives the most economical drive, and it is often necessary to calculate and price each drive, and compare them before the proper choice is made. The table footnote is a guide to the belt section that results in the most economical drive for a particular application. Larger diameter sheaves sometimes permit fewer belts on the drive. This not only reflects a saving on both the original set and replacements, but actually lowers initial cost of the complete drive. Part of the saving is effected in the lower price of the sheaves. Because of machining costs it is almost always true that sheaves of slightly larger diameter but with fewer grooves for a given drive are lower in price than sheaves of slightly smaller diameter but with more grooves.

Multiple Belts. If multiple belts are used, a slight increase in diameter of sheaves is often enough to increase the horsepower-transmitting capacity of the drive to the point where fewer belts do a satisfactory job. For instance, D section belts on a 13.0-in. sheave driven by an 1150-rpm motor have a rating of 15.3 hp each. Used on a 14.0-in. sheave, they have a rating of 17.9 hp each, or 2.6 hp more for each belt.

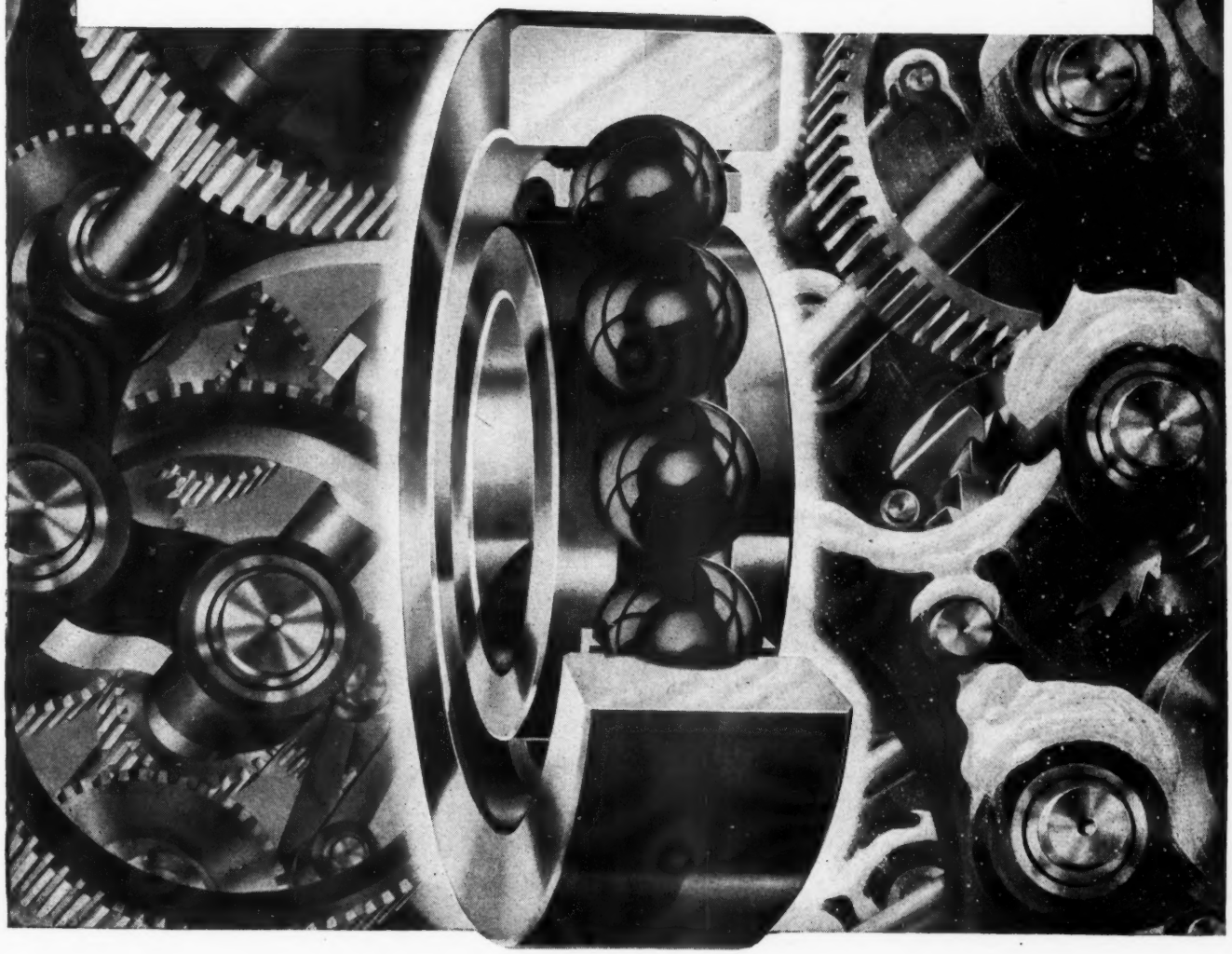
On the first drive eight belts have a total rating of 122 hp, while on the second drive only seven belts have a total of 125 hp. Second drive not only has a greater total horsepower-transmitting capacity but is actually lower in price than the first. So it would be more economical as well as a better-engineered drive.

Similarly, on certain drives, a fewer number of larger belts on larger-diameter sheaves often have equal or greater horsepower-transmitting capacity than a greater number of smaller belts on smaller-diameter sheaves. Where this is possible, the drive with the larger belt section is often preferable from an engineering standpoint, and almost always lower in first cost.

It is this principle of selection that is used in the pre-engineered or pre-selected drive sections in V-belt catalogs. Stock drives for normal applications of all kinds are wholly or partly calculated, and only those listed that are best from an engineering angle as well as lowest in first cost and maintenance. This assures the most economical drive for an application without the necessity of a customer having to engineer it himself. It's money in his pocket to use the most economical drive.

How to Keep Your Bearings

in a Furnace . . . or a Freezer!



New Lubricants by Socony-Vacuum Meet Extreme Conditions

You'll find the worst weather in the world in modern industry . . . from sizzling hot spots of 300 and 400°F., to chilling cold far below zero.

To protect bearings under these extreme conditions, Socony-Vacuum has developed two new special lubricants. Gargoyle Grease BRB Hi-Temp resists deterioration on bearings inside kilns, ovens, driers and other hot spots. Gargoyle Grease BRB Zero remains soft, resists drag on bearings in cold storage and pre-cooler rooms and outdoors in Arctic weather. It still gives satisfactory service at normal temperatures.

Here again is another example of our Complete Lubrication Service for your plant—service that has grown through 82 years' experience to help you keep your bearings.

Socony-Vacuum

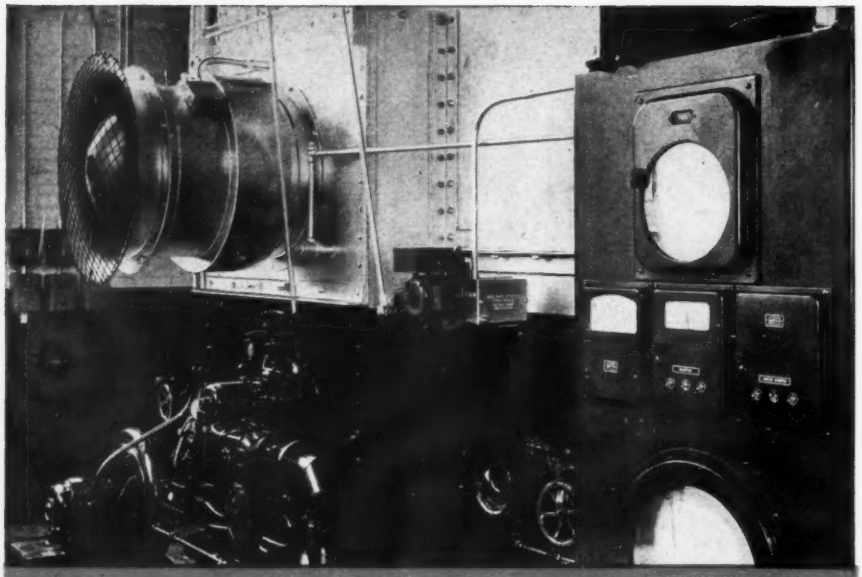
Correct Lubrication

SOCONY-VACUUM

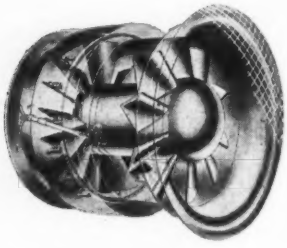
GARGOYLE

Lubricants

SOCONY-VACUUM OIL CO., INC., and Affiliates
MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP



The Wing Blower is "working out to the fullest satisfaction of everyone"



Wing EMD Blower showing simple design and built-in volume control. Internal radial dampers are actuated by an external balanced lever. Can be adjusted manually or by combustion controls.

That comment "to the fullest satisfaction of everyone," quoted from a recent letter, is characteristic of Wing Blower installations. For these Axial Flow Blowers are *built* to give satisfactory performance . . . simple and rugged construction, compact design with built-in capacity regulating dampers, combining high efficiency with quiet performance. Installation costs, too, are low. Write for descriptive bulletin or specific details.

L. J. Wing Mfg. Co. 50 - 7th Avenue, New York 11, N. Y.
Factories: Newark, N.J. and Montreal, Canada

Wing

AXIAL FLOW BLOWERS

the primary. For the ampere-turns to balance in the two windings, each winding will have the same current. For example, if the winding has 230 turns, there are 115 in the primary and 115 in the secondary. With 10-amp load, 5 amp is supplied by the primary half and 5 by the secondary half. Then, ampere-turns in each half of the winding are $5 \times 115 = 575$.

If the tap is moved from *B* toward *C* secondary volts will be reduced, because there are fewer turns included between the secondary leads. Moving the tap nearer to *A* increases the secondary volts.

An autotransformer can also be used to step up voltage by using the tap and one outside terminal as the primary, and the two outside terminals as the secondary, Fig. 16. Here we have 115 turns providing the magnetic flux that loops through 230 turns to double the voltage.

Autotransformers cost less to build but have the disadvantage of the secondary being connected to the primary. Under many conditions this is a serious hazard to life and equipment. They are used in electronic circuits for line-voltage adjustment, either to change it or to keep it constant. Load voltage may be adjusted with a tap switch as in Fig. 17.

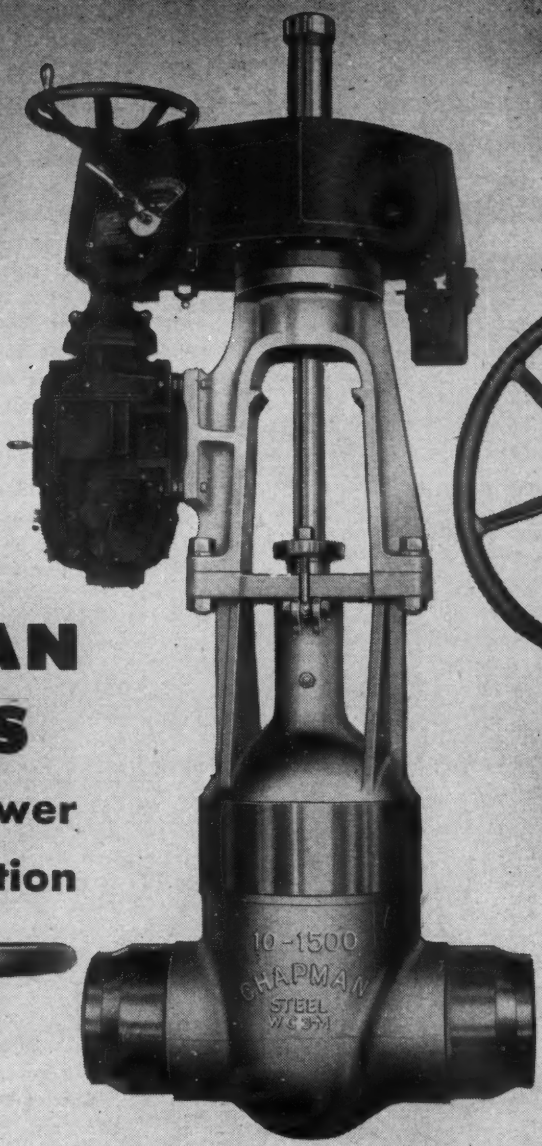
Peaking Transformer. A peaking transformer is a special design, used to control current flow through gas-filled tubes where accurate timing is required. This transformer produces a steep, secondary voltage wave for a short period at the end of each alternation. In the design, Fig. 18, the primary coil is on a leg of the core of a large cross section, and the secondary on the right leg of a small cross section. Between the two legs is a third one of large cross section and a short air gap.

When ac voltage is applied to the primary coil the magnetizing current produces a magnetic-flux wave like *A*, Fig. 19. Because of the air gap in the middle leg and the high magnetic permeability of the right-hand leg all the magnetic flux passes through the latter until it becomes saturated at *S*. From this point the remainder of the flux passes through the middle leg and it remains practically constant through the secondary coil as far as point *R* on the primary flux curve *A*, as indicated by curve *B*. Because the flux remains constant in the right-hand core leg from

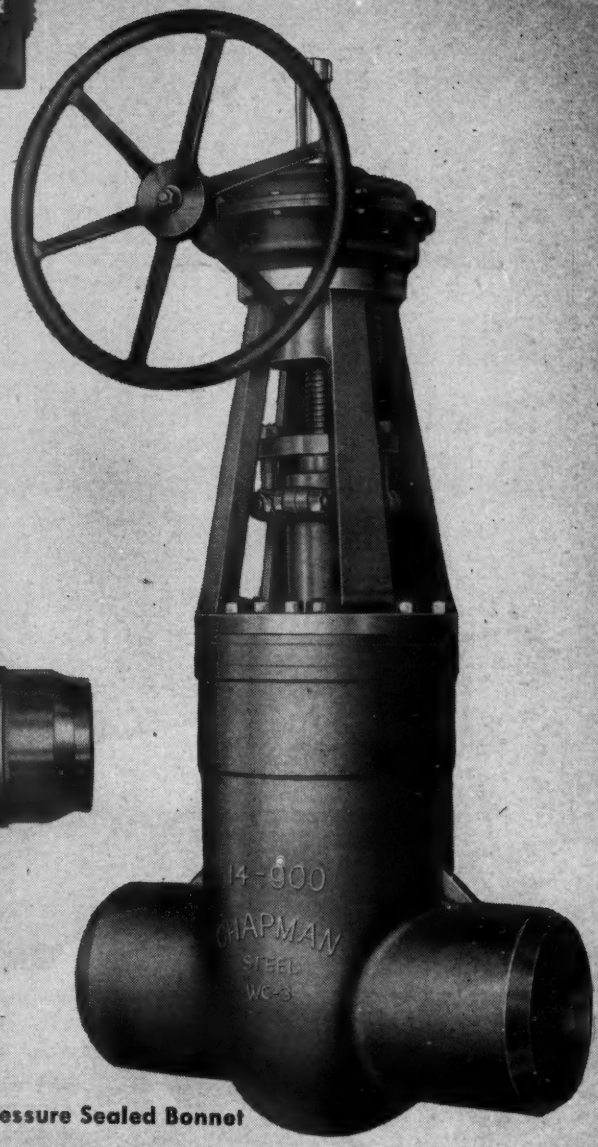
See all 3 types at
the Chapman Exhibit
THE POWER SHOW
Booths 46 and 47

CHAPMAN VALVES

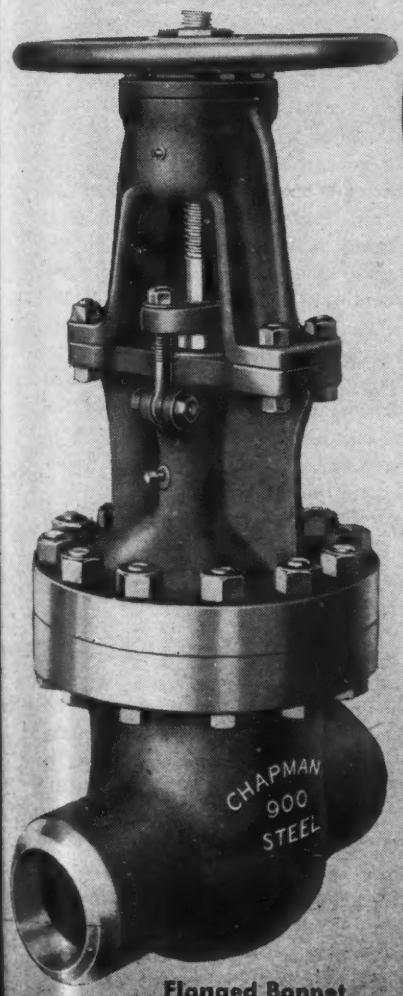
Meet Every Power Plant Specification



Welded Bonnet



Pressure Sealed Bonnet



Flanged Bonnet

Chapman builds valves to meet every power-plant specification—every pressure and temperature range. Chapman high pressure valves are available IN THREE TYPES of body and bonnet connections . . . welded, pressure sealed or flanged. All have straight-through ports and are manufactured to full A.S.A. standards for port diameters and wall thicknesses.

The Chapman Valve Manufacturing Co., Indian Orchard, Mass.

ADSCO

heat exchangers

all shapes and sizes

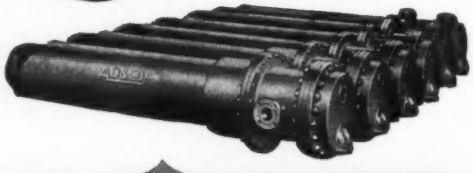
• Made of carbon steel, copper-silicon alloy, stainless steel, nickel clad and other materials.

Storage Heaters

Steam Tube Type Instantaneous Heater

Float Head Type for various services

Swimming Pool Heaters



Suction Type Heaters

AMERICAN DISTRICT STEAM CO.
NORTH TONAWANDA, N.Y.

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Pittsburgh, Atla. 6083
RHODE ISLAND
Providence, Dexter 4700
SOUTH CAROLINA
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SOUTH DAKOTA
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El Paso, Main 1787
Houston, Hadley 9574
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San Antonio, Lambert 2-9681
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MEXICO
Mexico City, 18-56-08

S to R, voltage in the secondary coil has remained at zero. At point R all flux is going through the right-hand leg. From R down to T on the curve the flux decreases to zero, reverses and increases to T in a short time. This rapid flux change induces a sharp peak voltage in the secondary, as indicated by curve E.

This voltage, when applied to the grid of a gas-filled tube, can control current flow through the tube to within one-thousandth part of a second. There are other constructions of these transformers but they all operate in the way described.

The next article will deal with capacitors by themselves and in combination with reactors. Following this we will get back to electron circuits, beginning with rectifier operation.

London Station

(*Continued from page* 128)

The deaerator will remain in operation even when the turbine is shut down to insure a supply of oxygen-free feedwater to banked boilers.

Each unit will have two 100%-capacity boiler feed pumps running at 3000 rpm. They will be interconnected on suction and discharge; of four pumps, three will be motor driven and one steam-turbine driven.

Cooling-Water System. For the first two units, four main circulating pumps are being provided, each rated at 26,700 gpm so any three can supply the full cooling-water requirements of the two units.

The circulating-water circuit will be of the siphonic type. Inlet water will be drawn from the near side of the river and outlet water discharged to the far side to avoid recirculation under tidal conditions.

Boiler Plant. The ultimate station will have eight 300,000-375,000-lb-per-hr boilers generating steam at 950 psig and 925 F. Full station steam requirements can be generated by six boilers operating at 93½% of their maximum continuous rating.

The boilers are designed to burn bunker C oil. Certain fuel oils may have undesirable characteristics causing fouling and slagging of the heating surfaces if they contain certain constituents in even small quantities. These deposits cannot be easily removed by normal methods of soot blowing and air lancing. But they are soluble in water, which enables the surfaces to be kept clean if washing means are ade-

Is THIS the pump you need?

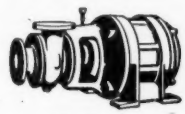
THE *Electrifugal* PUMP

IT'S COMPACT Pump and motor are combined in one rigid cast iron frame. Fits easily into close quarters—is quickly installed as a "package," and operates in any position—no shafts to align. Just bolt it down, make power and pipe connections, and start pumping. Capacities 15 to 1400 gpm, heads to 500 ft.

IT'S EFFICIENT Drip-proof motor is of Allis-Chalmers Lo-Maintenance design, specially built for pumping service. Pump has such long-service features as bronze wearing rings, new plastic water seal, five or more rings of packing, and first class construction throughout. Every unit is factory tested for efficiency, capacity and head.

IT'S AVAILABLE Many sizes of the Electrifugal and other smaller Allis-Chalmers pumps are now in stock for immediate delivery. Perhaps the size you need is ready. Phone or wire your nearest Allis-Chalmers office or dealer for up-to-the-minute information on availabilities and deliveries. For information on the complete A-C line of centrifugal pumps, ask for Bulletin B6059D. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN. A 2381

PEDRIFUGAL
The new A-C pump for flexible Texrope V-belt drive. Capacities to 500 gpm, heads to 100 ft.



SS UNIT
Close-coupled pump and motor units, made in 234 standard ratings, to 2500 gpm.

Electrifugal, Pedrifugal, SS Unit and Texrope are Allis-Chalmers Trademarks.

ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment—Biggest of All in Range of Industrial Products

At the POWER SHOW..

See LADISH

LADISH
A Complete Line of Controlled Quality FORGED and SEAMLESS WELDING PIPE FITTINGS
CONTROLLED QUALITY
SERVICE
wherever RELIABILITY counts most

We Invite You to Call

AT BOOTHS 613-614

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING

November 29 through December 4, 1948 — Grand Central Palace, New York

On display you will find the Ladish line of forged and seamless welding fittings . . . the Controlled Quality line that offers a complete selection of all your fittings needs — Seamless Welding Fittings . . . Forged Steel Fittings . . . and Forged Steel Flanges . . . complete in size range . . . available in Carbon, Stainless and Alloy steels. The Ladish heat code . . . symbol of Controlled Quality . . . appearing on every Ladish fitting is evidence of our pledge to supply at any time laboratory proof of the metallurgical soundness of any Ladish fitting.

BE SURE TO EXAMINE THESE LADISH ENGINEERING DEVELOPMENTS

New Seamless Reducing Elbows

• Saves space . . . saves welding cost . . . eliminates an extra fitting . . . improves flow efficiency.

New Full Branch Tees

• Scientific metal distribution . . . increased strength . . . reinforced crotch . . . full branch outlet.

A COMPLETE LINE PRODUCED UNDER ONE ROOF
. . . ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

DISTRICT OFFICES- New York • Buffalo • Pittsburgh • Philadelphia
Cleveland • Chicago • St. Louis • Atlanta • Houston • Los Angeles

the *Controlled Quality* LINE

COMPLETE WITH ALL THREE

SEAMLESS WELDING FITTINGS

Carbon, Stainless and Alloy steels. Complete range of types and sizes . . . ½ inch through 30 inches, Standard through Double Extra Heavy.

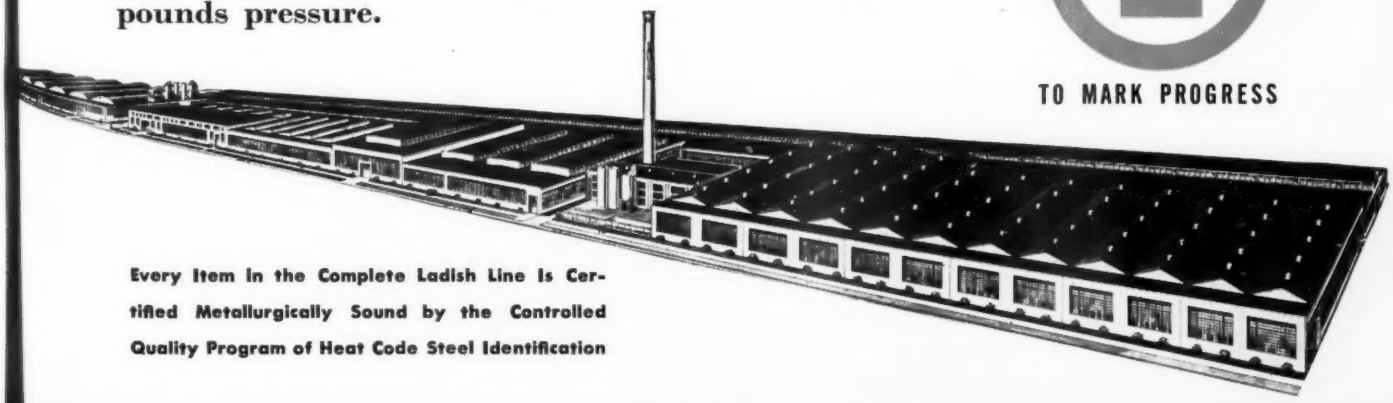
FORGED STEEL FLANGES

Carbon, Stainless and Alloy steels. Complete range of types and sizes . . . ½ inch through 30 inches, 150 through 2500 pounds pressure.

FORGED STEEL FITTINGS

Screwed and Socket-Welding. Carbon, Stainless and Alloy steels. Complete range of types and sizes . . . ⅛ inch through 4 inches, 2000 through 6000 pounds pressure.

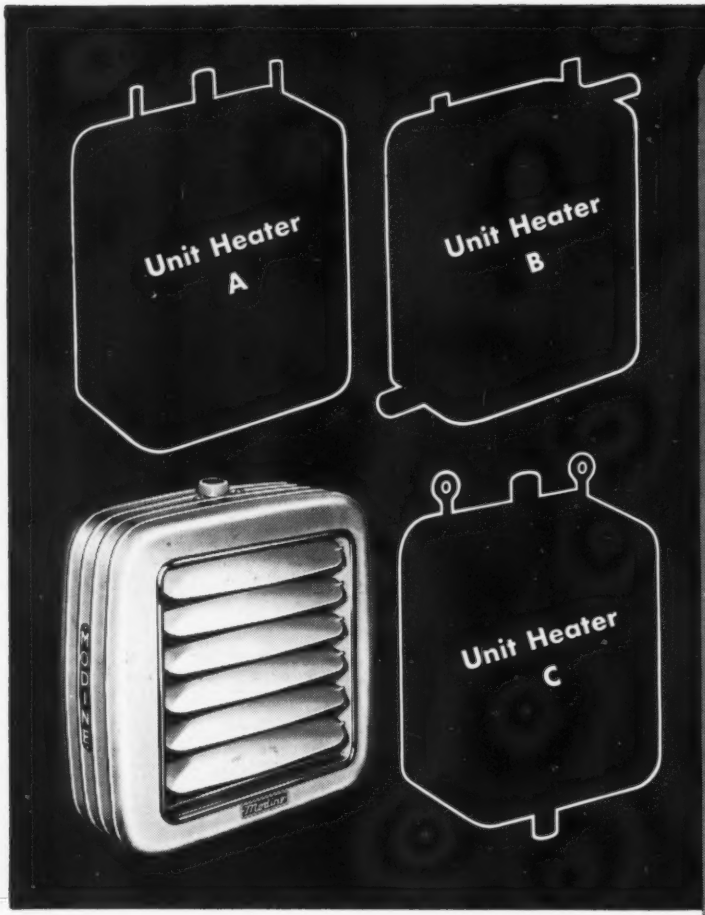
TO MARK PROGRESS



Every Item in the Complete Ladish Line Is Certified Metallurgically Sound by the Controlled Quality Program of Heat Code Steel Identification

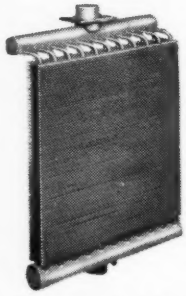
To everyone about to order unit heaters, Modine says,

"Look before you buy!"



MODINE MAKES THIS SPECIAL OFFER!

When you buy from sight, you buy right. That's why it will pay you to call your Modine Representative. He'll bring an actual Modine Unit Heater to your office. Check its attractive appearance, its sound engineering, its rugged construction. And when you do — you'll see why Modine leads the unit heater field.



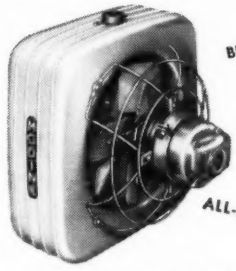
ONE-PIECE INTEGRATED CONSTRUCTION

ALL-COPPER COILS

INDIVIDUAL TUBE EXPANSION

Look at Modine Copper Coils

Find out how all-copper construction of Modine coils resists corrosion due to electrolysis. It means savings in your pocket from reduced maintenance expense.



BUILT-IN SAFETY FAN GUARD

SOUND-SILENCED

ALL-AROUND BEAUTY

Look at Modine Velocity Generator

See how this exclusive Modine feature gives you increased heat-throw without raising motor power requirements. Yes — with Modine you get better heating at no increase in cost.

YES, look before you buy.. and you'll buy Modine!

Look . . . examine . . . compare. Get the facts about all unit heaters and your best judgment will tell you — "Buy Modine!" Here's why. Only Modine gives you ALL these important features: Modern Beauty . . . All-Copper Coils . . . Peak Performance . . . Easy Installation . . . Smooth Operation. What's more you can choose from Modine's complete line of 3 types and 47 capacities to meet your specific heat, air delivery, height and location requirements.

See why Modine is years ahead in unit heater engineering. Call your Modine Representative for all the facts. He's listed in the "Where-to-Buy-It" section of your phone book. Or write direct. Modine Mfg. Co., 1512 Dekoven Ave., Racine, Wis.

Modine UNIT HEATERS

Inside the Great Bend, Kansas plant of the Central Kansas Electric Cooperative — the first R. E. A. power plant in Kansas and the first Supercharged Dual Fuel central station in the world. Manager Bill Groh at the control of one of two Worthington Type SEHGO-8 Dual Fuel Diesel Engines.

"TOTAL FUEL AND LUBRICANT COST PER KWH—$0.0015+!"

Kansas R. E. A. Station Reports Steady Savings With Worthington Supercharged Dual Fuel Diesels

One way to get the real low-down on economical generation of electric power is from a progressive R. E. A. plant. Here, in part, is what the Central Kansas Electric Cooperative Association has to say about its Worthington Dual Fuel Diesel equipment:

"Our engines have run approximately 3050 and 4100 hours, respectively, under loads varying from 300 to 1160 KW. Operation has been satisfactory at all loads.

"One remarkable point is the low lubricating oil consumption . . . Also, we have had very little maintenance work.

"The past month the total fuel and lubricant cost per KWH generated has been 1.517 mills. . . . The saving of gas over fuel oil is very great.

"A fire necessitated shutting off our gas line for 12 hours. We switched to oil Diesel operation without any interruption."

Economy In Every Detail

With Worthington Dual Fuel Diesels you get outstanding thermal efficiency on the cheapest fuel available — oil, gas or oil-and-gas in any ratio — while Worthington's long leadership in developing Diesel design and performance means additional power for every operating-dollar you spend. For further proof that *there's more worth in Worthington*, contact *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.*

WORTHINGTON

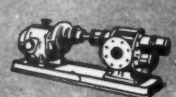
Ee-2

YOUR PARTNER IN POWER PROGRESS

Diesel engines, 150 to 2,640 hp . . . gas engines, 175 to 1,720 hp . . . dual fuel engines, 225 to 2,640 hp.

WORTHINGTON-BUILT AUXILIARIES

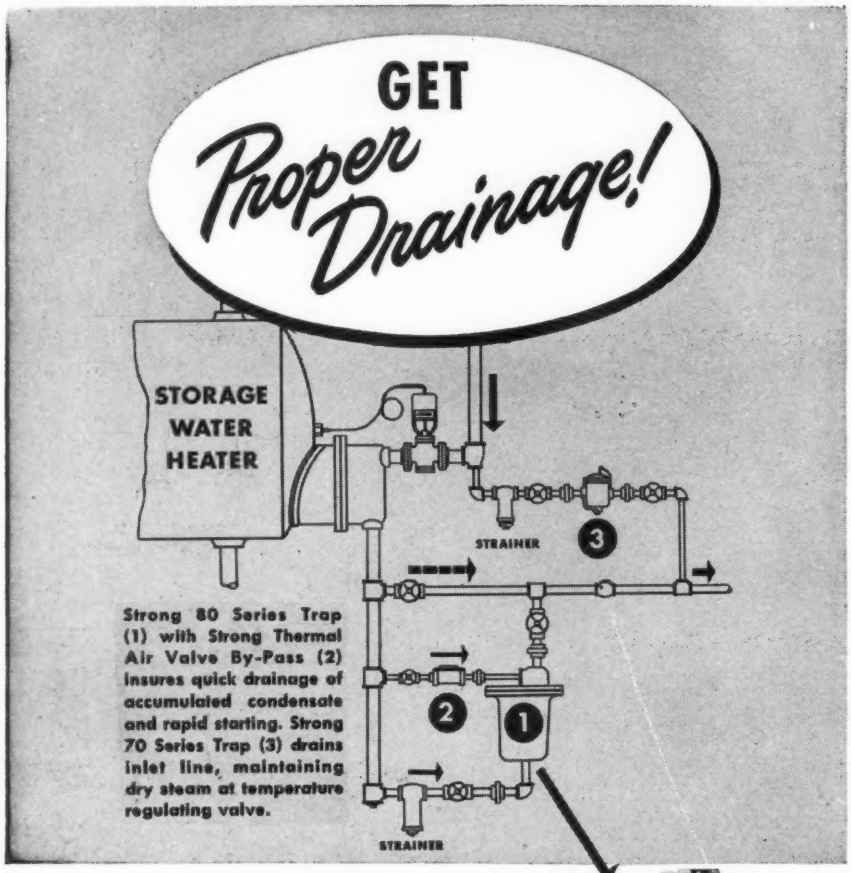
Air King Compressors



Oil Transfer Pumps

Cooling Water Circulating Pumps

Evaporative Type Engine Water Cooler

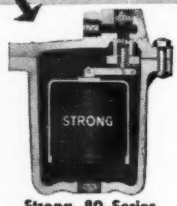


Strong 80 Series Trap (1) with Strong Thermal Air Valve By-Pass (2) insures quick drainage of accumulated condensate and rapid starting. Strong 70 Series Trap (3) drains inlet line, maintaining dry steam at temperature regulating valve.

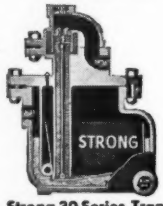
PROBLEM: Condensate accumulates in coils due to lack of pressure when thermostatic regulating valve is throttling or closed. *Improper drainage and water hammer result when thermostatic valve opens.*

SOLUTION: *Drain coils fast.* Use trap with four to eight times capacity of actual steam condensate rate. For medium or high pressures, either open or inverted bucket traps are suitable. *Use open bucket traps for low pressures.*

Completeness of the Strong trap line enables our engineers to recommend exactly the type or size you need—open or inverted bucket, closed float, float-and-thermostatic (blast), etc., forged, welded, cast or semi-steel construction. Bring your drainage problems to us for solution. Send for Strong Trap Catalog No. 67 today for complete details of *all* Strong traps.



Strong 80 Series Trap for medium or high pressures.



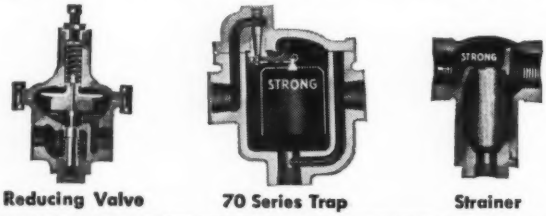
Strong 30 Series Trap for high, medium or low pressures.

STRONG, CARLISLE & HAMMOND COMPANY
1392 West 3rd Street
Cleveland 13, Ohio

REG. TRADE MARK

ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES



Reducing Valve | 70 Series Trap | Strainer

STRONG

quate. Design of the boilers disposes the various heating-surface components so they may be washed independently and the sludge collected.

The completely watercooled furnaces will develop full-load heat release of 25,000 Btu per hr per cu ft. Primary and secondary convection superheaters, bare-tube economizers, tubular air heaters and duplicate 2-speed forced- and induced-draft fans will be provided.

Care is being taken that the products of combustion shall not damage the facade of St. Paul's Cathedral across the river. All flue gas will be thoroughly washed before discharging to atmosphere, on the same principle successfully used in Battersea Station. The washing plant will be in the center of the boiler room, occupying the space equivalent to about 2½ boilers.

Oil Storage. Estimated annual oil consumption for the ultimate station equals about 230,000 tons, the winter weekly rate for 2-shift operation being about 5330 tons. Six oil-storage tanks will have a capacity of 4000 tons each. After allowing for normal cycle of filling and emptying it is estimated this tank capacity will equal three to four weeks' supply at the winter consumption rate.

Steel tanks will be in underground reinforced concrete enclosures; tops, provided with concrete roofs, will be grassed over. Oil will be available in bulk at oil depots down the river. Motor-driven barges will run a shuttle service between depots and station.

Plant Problems

(*Continued from page* 140)

No General Rule Available

BECAUSE OF different climatic and loading conditions, it is impossible to establish a general rule in answer to *FAA's* question. But I find POWER's *Question and Answer Book* sums up the problem nicely as follows:

"Useful cable life depends on many variables including amount of use, hoisting speed, loading conditions, abrasive dust or corrosive fumes, etc. This makes it impossible to establish a general rule either for normal life or for frequency of inspection . . . judgment is the most important factor. . . . It is vital to inspect all rope fastenings . . . such as clips, clamps and sockets for broken wires, tightness and to prevent ropes from pulling out."

D J PARMER *Quincy, Fla.*

How coal is wasted

STACK LOSSES Smoke is only one of the ways in which you may waste fuel through your stack. Even more serious losses may result from excess air or high stack temperature, both of which are invisible.

PREMIUM COALS Many steam plants carry a heavy cost burden when they burn premium grade coals in an effort to comply with local smoke ordinances.

UNEVEN FIRING Steady steam pressure is impossible to maintain with hand firing. When steam pressure varies, fuel is wasted.

ERRATIC AIR SUPPLY For efficient combustion the correct fuel-air ratio must be constantly maintained. This is possible only when air supply is controlled by precise automatic instruments.

COKE IN ASH—a common source of waste. Iron Fireman completely burns all combustibles in the coal.

How to stop it

HAVE an Iron Fireman technical man check your boiler plant at once. This will cost you nothing. He will make an Iron Fireman analysis of your steam operation and give you a written report showing where your fuel dollars go. If your situation indicates that an Iron Fireman stoker installation would be a profit opportunity for you, there'll be no guesswork about it. You will know in advance what you can expect in fuel savings, increased steam production, labor savings and other operating betterments and economies.

Iron Fireman Poweram stokers combine worm feed with ram distribution. Coal is delivered to fire in loose, well aerated condition by worm conveyor and is then distributed by reciprocating ram blocks in the base of the retort.

WRITE FOR BOOKLET

"Iron Fireman Stokers for Heating and Power." Address Iron Fireman Manufacturing Company, 3274 West 106th Street, Cleveland 11, Ohio. Other plants in Portland, Oregon; Toronto, Canada. Dealers everywhere.

THE IRON FIREMAN

IRON FIREMAN

Automatic Firing

This beats a magic carpet!

Air Express can bring you supplies and equipment from any U.S. point—*overnight*. And that's better than old-style magic! Air Express is the fastest way you can find to ship or receive. No delays, because shipments go on every flight of the Scheduled Airlines.

What's more you get special door-to-door service at no extra cost. With low Air Express rates, you can use this fastest service as a regular procedure. Let Air Express keep your business running fast—and smoothly.

Specify Air Express-World's Fastest Shipping Service

- Low rates—special pick-up and delivery in principal U.S. towns and cities at no extra cost.
- Moves on all flights of all Scheduled Airlines.
- Air-rail between 22,000 off-airline offices.

True case history: Rubber equipment users regularly get replacement parts by Air Express so machines won't stand idle. Recent shipment: 102-lb. carton picked up 5 P.M. the 18th in Noblesville, Ind. Air-rail to Dallas, delivered 9 A.M. following day. 799 miles, total cost only $26.78. Any distance inexpensive, too. Phone local Air Express Division, Railway Express Agency, for fast shipping action.

AIR EXPRESS

AIR EXPRESS — GETS THERE FIRST

Rates include pick-up and delivery door to door in all principal towns and cities

AIR EXPRESS, A SERVICE OF RAILWAY EXPRESS AGENCY AND THE

SCHEDULED AIRLINES OF THE U.S.

Technical Briefs

(*Continued from page* 154)

0.30 ppm average. This improvement comes directly from the new drum internals. Samples at the saturated header drain read 0.66 ppm, and at the superheater sampling points 1.0 ppm. *ASME Paper, Spring 1948 meeting. No copies available.*

REPAIRING BLADES OF ADJUSTABLE-BLADE TURBINES WITH STAINLESS STEEL, *by Joel B Justin, consulting engineer, and E T Davis, Indiana Michigan Electric Co.* Describes methods of repairing blades of adjustable-blade hydraulic turbines with stainless steel and using precast-blade stainless-clad inserts at the plants of the Kanawha Valley Power Co. About 5 tons of welding rods were used in repairing cavitation of 646 sq ft of blade area in the London, Marmet and Winfield plants.

Marmet and London plants are identical. Put in service in 1933, they operate under 24-ft normal head. Each plant has two adjustable-blade turbines, rated 7600 and 7250 hp, and one 6600-hp fixed-blade unit. The Winfield plant, which went into operation in 1937 under a 28-ft head, has three 9200-hp adjustable-blade turbines.

These plants operate at high-capacity factors and at reduced head a large part of the year because of high tailwater. Several units run over 8000 hr per year. They operate above their rated capacity, which no doubt increased the pitting of the runner blades.

Although somewhat different repair methods were used on some of the units, in general the same procedure was followed on all. The Winfield units were cavitated more as to area and severity than at Marmet and London. Often periphery of the blades was entirely gone, with holes through the trailing ends. There were 98 sq ft of this surface to repair on the blades of each unit. The cast throat rings were cavitated ¾ in. deep by 2 ft wide, and in places holes went through the 1¼-in. steel casing. On these rings, an 87-sq-ft area had to be repaired, making a total of 185 sq ft on each unit. The paper describes these repairs in detail including shaft sleeves repaired by metal spraying and machining in place. *ASME Paper No. 48-F-1.*

The 31st annual convention and business meeting of National Coal Assn was held Oct 4-6 at the Waldorf-Astoria in New York.

ONLY ONE

ANTIMONIAL ADMIRALTY HAS STOOD THE TEST OF TIME

CHASE

and only CHASE can make it!

For 13 years Chase Antimonial Admiralty Condenser Tubes have given great performances in industry. Here's why:

Admiralty with an antimonial content of less than .007% (the minimum set forth in Chase Patent No. 2,061,921) cannot be depended upon to prevent dezincification. Under the entire range of conditions, a minimum of about .015% is essential for reasonably complete protection. The antimonial content of Chase Admiralty is nominally .035%... which allows for commercial variation sometimes encountered and thus *assures* you this .015% minimum.

Only Chase can supply you with this patented Antimonial Admiralty because only Chase can make it, and it costs no more than plain Admiralty.

Special stocks of ANTIMONIAL ADMIRALTY Condenser Tubes in Chase Warehouses* BALTIMORE, NEW ORLEANS LOS ANGELES, SAN FRANCISCO
also carried by—
Vinson Supply Co., Tulsa
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Chase

the Nation's Headquarters for
BRASS & COPPER

WATERBURY 91, CONNECTICUT — SUBSIDIARY OF KENNECOTT COPPER CORPORATION

THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

ALBANY† ATLANTA BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DETROIT HOUSTON† INDIANAPOLIS KANSAS CITY, MO. LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† SAN FRANCISCO SEATTLE ST. LOUIS WATERBURY (†Indicates Sales Office Only)

PROGRESS ON PARADE at the

Under Auspices of American Society of Heating & Ventilating Engineers.

Striking advances in equipment . . . the latest trends and practices—newest and best ways to efficiently heat, ventilate and air condition all types of industrial plants—a wealth of practical, cost-saving ideas—are in store here for plant service personnel. Greatest display of its kind ever assembled, its informative, technically-staffed exhibits and demonstrations will afford unequalled opportunity to see and compare at one time hundreds of new and improved items from complete units to maintenance supplies—to discuss your specific plans, problems and requirements first-hand with engineering specialists.

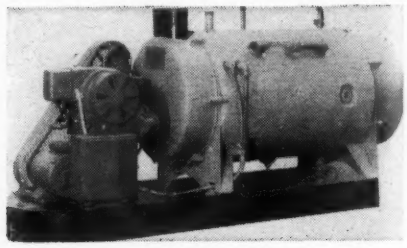
Because of today's rapid advances in these important fields, no plant official, architect, engineer, or operator responsible for providing and maintaining these vital services in any branch of industry can afford to miss this outstanding display of progress. Plan now to attend—note the date.

——Management International Exposition Company——

New Equipment

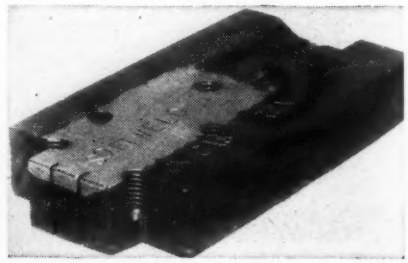
(*Continued from page* 146)

parts to wear, the valve is actuated with only four ounces pressure. Its stem is mounted on ball bearings to assure smooth operation, with minimum drag. Because of its rotary design, the new valve can use to full advantage a tight-fitting, cup oil seal, to prevent oil leakage around valve stem. This valve is being installed on all new Reeves variable-speed transmissions using hydraulic controls. **Reeves Pulley Co, Columbus, Ohio.**



Hot-Water Generator E520

HIGH-CAPACITY, two-size 550,000-Btu-output, or 665 gal per hr at 100-F rise, and 730,000 Btu output, or 875 gal per hr at 100 F rise, hot-water supply can be achieved with oil- or gas-fired, automatic hot-water generators. A 4-pass shell gives high heat-transfer efficiency. **Cleaver-Brooks Co, 326 East Keefe Ave, Milwaukee 12, Wis.**

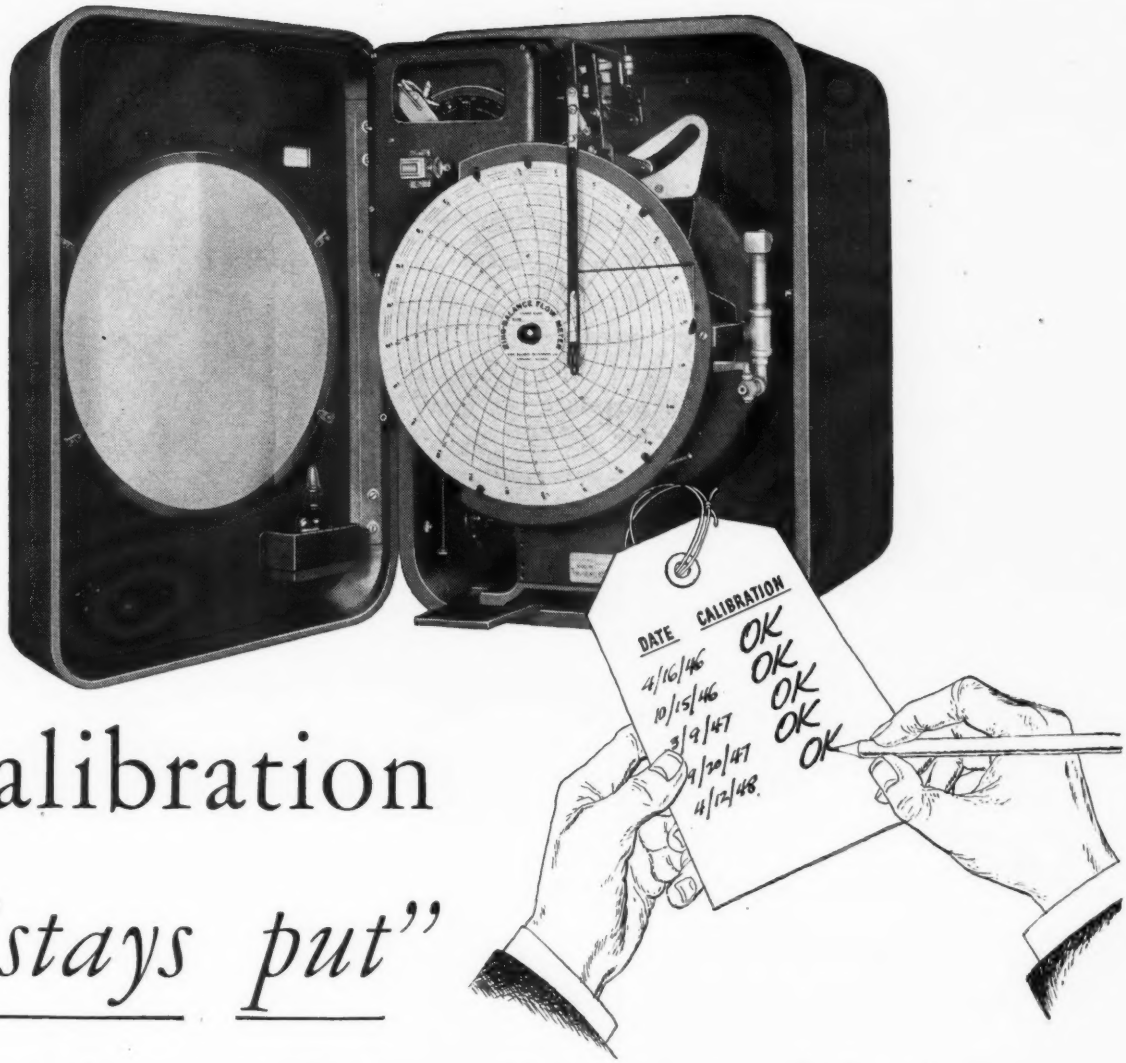


Nonferrous Electrode E521

DENSE, SOFT, MACHINABLE WELDS on gray iron castings may be had with *Softweld*, a nonferrous electrode operating on either ac or dc. Weld flows over and bonds to cast iron with a minimum penetration and heating of the base metal. Entire weld area may be drilled, machined, sawed or tapped. Electrode comes in 14-in. lengths and in 1.8- and 5.32-in. sizes. **Lincoln Electric Co, Cleveland 1, Ohio.**

Solenoid Valve E522

SERIES NO. 6000, 150-psi globe-type solenoid valve is specifically designed to meet emergency or safety requirements. Intended for service in which the valve is normally open, it is capable of remaining closed indefinitely. Valve has heavy cast-iron body for pressures up to 150 psi and is furnished with Jenkins disk construction



Calibration *"stays put"* in Hagan Ring Balance Meters

Once a Hagan Ring Balance Meter is properly calibrated for a given set of operating conditions, you can virtually forget it. Here's why:

1. **Calibration is independent of the quantity of the sealing liquid, so long as a seal is maintained.**
2. **Calibration is not affected by changes in density of the sealing liquid due to changes in ambient temperature.**
3. **No moving parts in contact with measured fluid.**
4. **No stuffing boxes.**

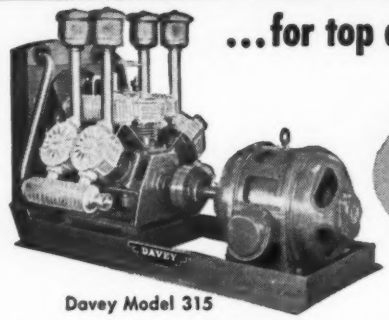
Just one more feature that is influencing more and more plants to *standardize* on Hagan Ring Balance Meters.

For full information, write for Hagan Bulletin 2M48. Hagan Corporation, Hagan Building, Pittsburgh 30, Pennsylvania.

HAGAN CORPORATION

HAGAN
HALL
BUROMIN
CALGON

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES



Davey Model 315

...for top air output *plus* economy

SPECIFY DAVEY DEPARTMENTAL *Compressors*

DAVEY DEPARTMENTAL COMPRESSORS GIVE YOU THESE ADVANTAGES

- Power savings
- Lower air losses
- Maximum air operating efficiency
- Make plant expansions easy and economical
- Eliminate shutdowns due to compressor failures
- Air cooling eliminates water bills
- Ease of installation
- Reduced maintenance and replacement expense

IN LINE with today's trend toward employment of small departmental compressors instead of one large centralized machine, Davey offers a complete line of industrial units.

These are available in 60, 105, 160, 210 and 315 c.f.m. capacities. And every Davey has GUARANTEED LIFETIME VALVES.

DAVEY COMPRESSOR CO. • KENT, OHIO

Write for Bulletin E-219

DAVEY

P&P-102

DAVEY COMPRESSOR CO. *Dealers in Principal Cities*

RESPECT Through PERFORMANCE

Another Outstanding Series of

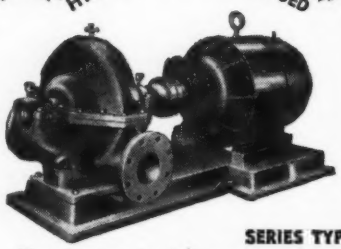
PUMPS *"by Aurora"*

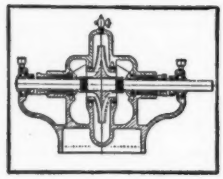
HORIZONTALLY SPLIT CASE · HYDRAULICALLY BALANCED · DOUBLE SUCTION SINGLE STAGE

AURORA CENTRIFUGALS *for Every Pumping Job*
HORIZONTAL SPLIT CASE *Single & Two Stage*
•
SIDE SUCTION
•
VERTICAL
•
NON CLOG
•
SUMP
•
CLOSE COUPLED
•
MIXED FLOW
•
SPECIAL DESIGN
•
DEEP WELL TURBINES

Write for **CONDENSED CATALOG "M"** *or*

SEE OUR CATALOG IN SWEET'S





SERIES TYPE OD

The ultimate in design and perfection, these Type OD Pumps are available in capacities to 4,000 G.P.M. and heads to 300 ft. Accessible, compact and lasting, Type OD Pumps are widely used for general water supply, for municipalities, industrial plants, office buildings, institutions. Also for handling condenser circulating water, wash water, liquids in paper mills and distilleries, chemical solutions, oil in oil fields and refineries, irrigation, etc.

APCO TURBINE-TYPE PUMPS

Here's the pump for "1001" duties. SIMPLE — only one moving part, the impeller. Capacities to 150 G.P.M., heads to 600 ft. Slight change in capacity against drastic head variations.

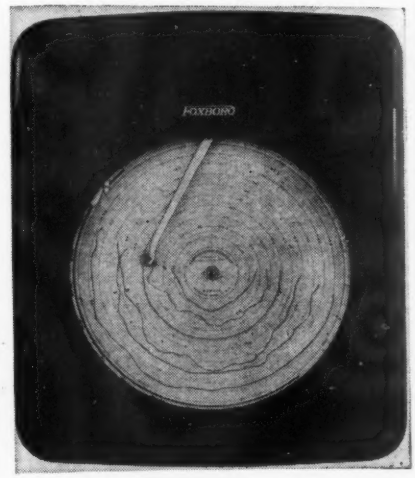
DISTRIBUTORS IN PRINCIPAL CITIES

AURORA Always PUMPS

AURORA PUMP COMPANY

50 Loucks Street, AURORA, ILLINOIS

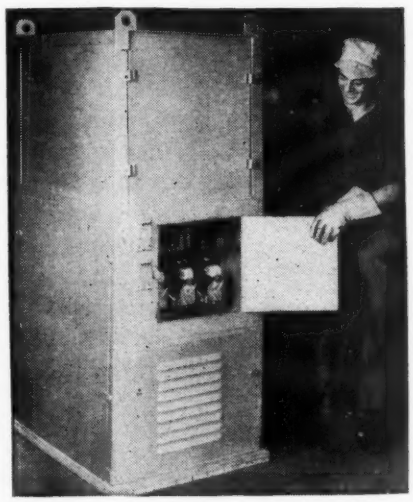
for steam, hot or cold water, gas, air, gasoline or oil. Valve is available in six sizes from $\frac{3}{4}$ to $2\frac{1}{2}$ in. and may be used on 110-, 220-, 440-v 60-cycle ac service. Valve cap has a $\frac{1}{8}$-in. pipe connection for an equalizing line to facilitate opening the valve after an emergency. **Johnson Corp, Three Rivers, Mich.**



Multi-Pen Recorder E523

HIGH-SPEED INSTRUMENT makes from one to six different records on one circular chart, the curves being of colored dots so closely spaced they look like a continuous line. Recorder has only one measuring system, either resistance bulb or emf type, but a positive-acting switching unit brings the varicolored pens into recording position at 6-sec intervals in any sequence desired.

Feature of the recorder is its *Rotacolor* pen wheel holding the six pens, which are magnetically selected in turn and held in recording position by a single pen arm. Special dry ink insures clean recording; instrument operates continuously for several weeks without need of reinking. **Foxboro Co, Foxboro, Mass.**



Air Conditioner E524

SMALL AIR-CONDITIONING UNIT designed for crane cab operates in ambient temperatures up to 130 F to maintain cab temperatures at 80 to 85 F in summer and 68 to 72 F in winter. The 5 ft, $5\frac{1}{8}$ in. high by 2 ft,

IT'S THOROUGHLY ENGINEERED

This carbon molybdenum steel pipe is 10¾ in. O.D. with 1¼ in. walls and is being bent to a radius of 2 diameters.

When the engineers call for piping for extremes in pressures and temperature, meticulous bending, and fabrication, Blaw-Knox Power Piping has the answers.

Bending and fabricating and installing big pipe as it should be done, requires special equipment and extensive experience. In this work, Blaw-Knox Power Piping has a long advantage.

It is not surprising that outsiders should exclaim, "I wonder how they do it!" when they see some of the thoroughly engineered piping assemblies that come from Blaw-Knox shops.

POWER PIPING

Division of Blaw-Knox Construction Company
1525 Pennsylvania Ave., N. S., Pittsburgh 12, Pa.
Offices in Principal Cities

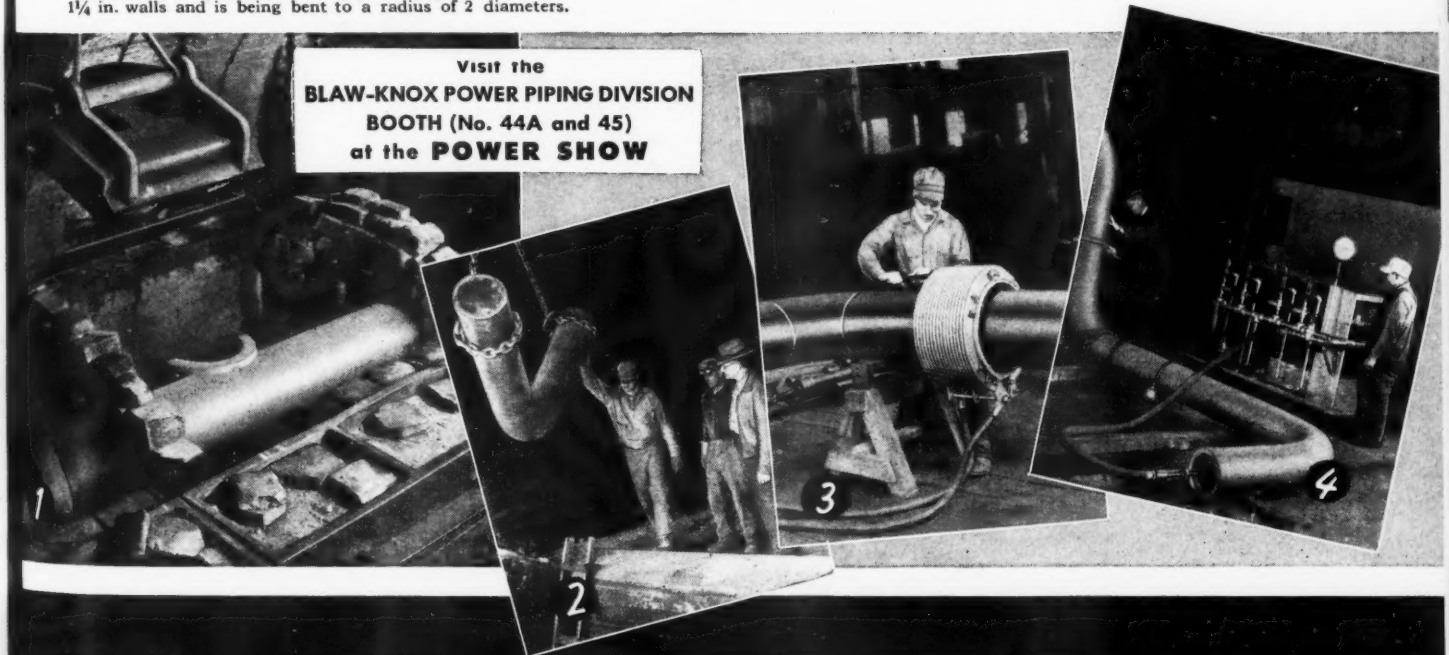
1 Heavy pipe in the bending furnace for heating preparatory to bending.

2 Over and down into one of our fourteen big annealing furnaces.

3 Stress relieving with heavy electrical induction heating unit.

4 And finally, the hydrostatic tests with pressures when required as high as 10,000 psi.

Visit the
BLAW-KNOX POWER PIPING DIVISION
BOOTH (No. 44A and 45)
at the POWER SHOW

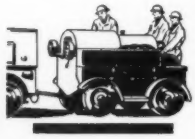


BLAW-KNOX POWER PIPING

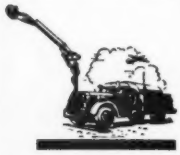
FIXED SYSTEMS
500 pounds to 125 tons of Cardox CO_2, stored in one centrally located Storage Unit. Automatic protection for single or multiple hazards.

FIRE TRUCK
Tons of CO_2 on wheels. May be used with fixed standpipe systems.

TRANSITANK*
Mobile plant protection by means of 750 pounds of Cardox CO_2.



FIRE TRAILER*
Especially designed for outdoor use. Carries both Cardox CO_2 and foam.



AIRPORT FIRE TRUCK
Stops vicious airport crash fires in seconds. World's most effective airport fire protection.

ENGINEERED FOR FAST, NON-DAMAGING

Extinguishment

OF TOUGH FIRES

How long since you've asked yourself these two $64 questions: *How hard would one bad fire hit our plant and production?* and *Where is it most likely to strike?* Hundreds of industries who have faced up squarely to these questions have found that the only *safe* answer is *complete* protection for *key* hazards—and that that protection can best be supplied by Cardox and *low-pressure* carbon dioxide.

For Cardox protects *three* ways. (1) By its amazingly quick extinguishment, Cardox CO_2 eliminates or reduces fire damage. (2) It causes *no* extinguishment damage whatsoever. (3) It can be applied with equal facility in pounds or tons. When it's Cardox you *know* there's enough of the extinguishing medium to do the job, for that is basic to the Cardox method, engineering and recommendations.

Get the facts on what Cardox protection means for *your* particular hazards. Write today for FREE survey and counsel or Bulletin No. 3128.

CARDOX OFFERS ALL THREE

EXTINGUISHMENT
Cardox engineered applications give carbon dioxide enhanced effectiveness for faster, surer extinguishment of large or small fires, indoors or out.

PREVENTION
Cardox Atmosphere Inerting Systems provide low-cost inert gas for continuous fire and explosion protection.

DETECTION
Cardox Detection Systems, actuated by heat, smoke or flame, operate as a warning device or to actuate fire extinguishing systems.

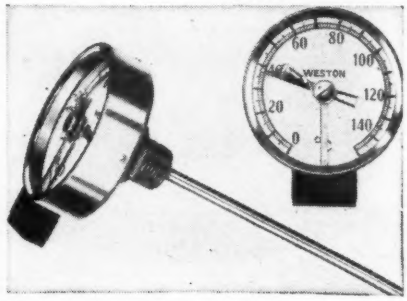
*Available in Many Parts of the Country

CARDOX
CO_2 FIRE EXTINGUISHING SYSTEMS

CARDOX CORPORATION • 307 N. Michigan Avenue, Chicago 1, Illinois

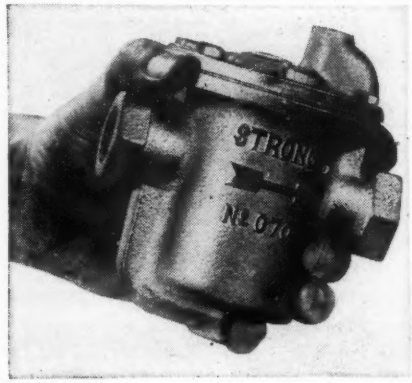
District Offices: New York • Philadelphia • Pittsburgh • Cleveland • Detroit • St. Louis • Los Angeles San Diego • San Francisco

2 in. by 2 ft, 9 in. unit can be mounted vertically alongside a crane cab or placed on adjoining catwalks. **Dravo Corp, Fifth and Liberty Ave, Pittsburgh 22, Pa.**



Thermometer E525

CONTACT-MAKING THERMOMETER combines the features of an indicating thermometer in addition to an alarm or control device. Contacts are of the magnetic type, and a screw-type terminal block mounted on the case periphery provides for easy electrical connection. Accuracy as an indicating thermometer is plus or minus 1% and as a control device 1½% of full-scale range. It is available in stem lengths from 2½ to 24 in. Longer stems are made to order. Contacts break on a temperature change of about 5%. **Weston Electrical Instrument Corp, 617 Frelinghuysen Ave, Newark 5, N. J.**



Small Steam Trap E526

No. 070 TRAP fits standard applications where small drainage is a problem. Available for pressures of 0 to 150 psi, the trap has renewable seat, 18-8 stainless-steel bucket, wear-resistant *Anum-Metl* valve and seat, and *Hi-Cap* orifice. Manufacturer recommends it for laundry and dry-cleaning equipment, unit heaters up to 150,000 Btu, coffee urns, steam tables, etc. **Strong, Carlisle & Hammond Co, Cleveland, Ohio.**

Turbine Pump E527

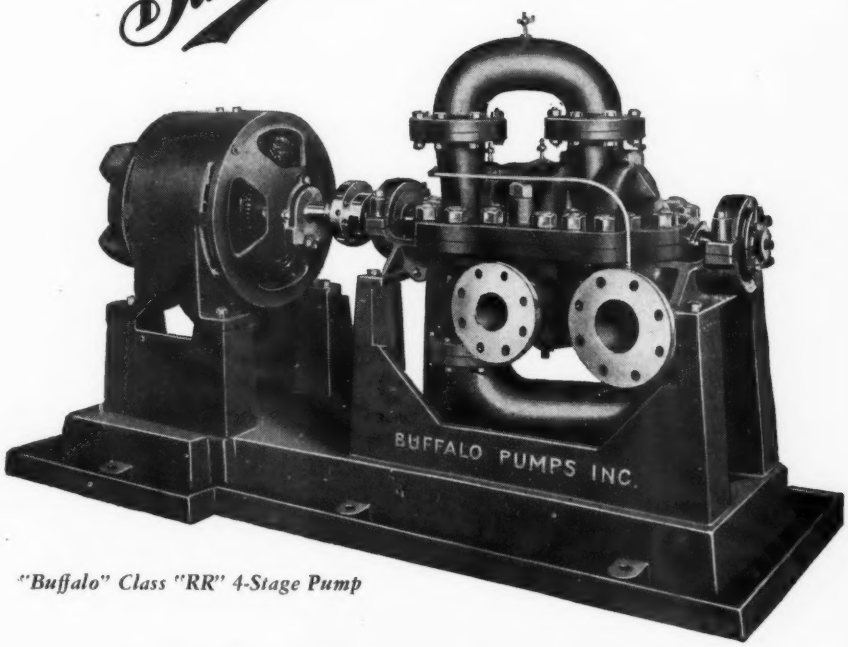
FOR SMALL-DIAMETER DEEPWELLS, this turbine pump is good for capacities up to 5000 gal per hr from depths up to 200 ft. It fills the gap—in water pumping from deepwells 4 in. in diameter and larger—that is often found between domestic-water systems and larger deepwell turbine pumps. Of an open lineshaft design, bowl and shaft bearings are lubricated by the well's water. No

CENTRIFUGAL PUMPS FOR EVERY LIQUID

ENDURANCE to SPARE

—in these high-efficiency "Buffalo" PUMPS!

PUMPS by "Buffalo"



"Buffalo" Class "RR" 4-Stage Pump

FOR CLEAR WATER, HIGH PRESSURES, ANY TEMPERATURE—

In buying a clear-water pump, as in any other type of pump, your primary concerns should be: (1) will it do the job to specification? and (2) what will it cost to run—not just now, but for years to come?

When you buy a recommended "Buffalo" Pump, you can be sure it will deliver *as specified*—the number of gallons per minute you want, at the head your installation calls for. And you can be sure of real power economy. Many "Buffalo" Class "RR" Pumps are operating at 75% efficiencies.

But maintenance savings are the big savings! All "Buffalo" Pumps are built *heavily* for endurance beyond what their service calls for. Every part is oversize—a "construction bonus" that means your pump will *keep delivering* through the wear and tear of hard service, year in and year out.

We'd like you and your staff to *see* the endurance and efficiency built into "Buffalo" Clear Water Pumps. Let us send you Bulletins 955-L and 980-B. Simply write:

For

- ★ WATER ANY TEMPERATURE
- ★ PAPER STOCKS (NON-CLOGGING)
- ★ GENERAL SERVICE
- ★ ACIDS
- ★ ALKALIS
- ★ SLURRY
- ★ CONDENSATE RETURN
- ★ SUMP CLEARANCE
- ★ FIRE SERVICE
- ★ SEWAGE
- ★ SELF-PRIMING SERVICE

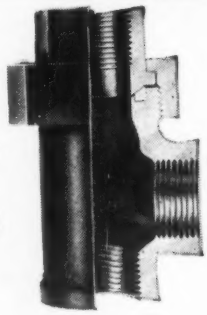
BUFFALO PUMPS, INC.

488 BROADWAY BUFFALO, NEW YORK

Canada Pumps Ltd., Kitchener, Ont.

Branch Offices in all Principal Cities

RUGGED, PRECISION CONSTRUCTION—FOR LONG LIFE



Jefferson All-Female Union Tee with union on the run. Made also in Male-Female type.

Jefferson

Specialty UNIONS

Save Time and Effort in Making Up Pipe Joints

Complicated piping installations can be greatly simplified and the number of pipe joints greatly reduced by the use of Jefferson Specialty Unions . . . available in 45° and 90° union elbows and union tees.

All types feature the exclusive 'Jefferson' Recessed Brass Seat providing surface contact, protection from pipe ends and unobstructed flow.

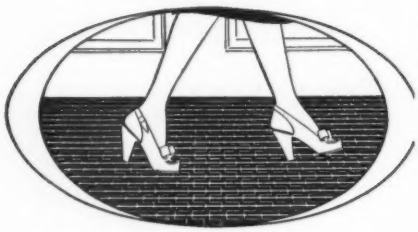
Get in touch with us direct or with your nearest distributor for your requirements.

JEFFERSON UNION CO.

605 West 26th St., New York 1, N. Y.
63 Gooding St., Lockport, N. Y.
39 Fletcher Ave., Lexington 73, Mass.

***The UNIONS with the Exclusive* RECESSED BRASS SEAT.**

THE **SAFE**
OPEN STEEL FLOORING
IS **TRI-LOK**



No object over ½ square inch can pass through super-safe U-Type Tri-Lok Flooring. Fabricated without bolts, rivets or welds, it is unsurpassed for plant installation, walkways, loading platforms. Efficient distribution of concentrated loads . . . maximum free opening for light and air. Write for Bulletin JZ 1140.

DRAVO CORPORATION

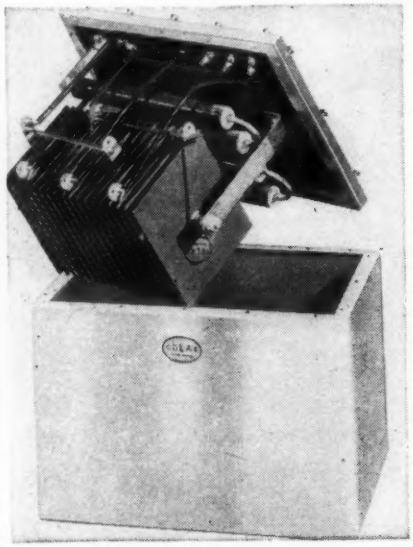
National Distributor for the Tri-Lok Company

Dravo Bldg., Pittsburgh 22, Pa.

Sales Representatives in Principal Cities

DRAVO

oil is used underground. It has semiopen impellers, streamlined porcelain-enameled bowl sections and rubber bearings. All shafting is stainless steel. Long, cutless, fluted rubber shaft bearings, spaced every 5 ft, are resistant to normal sand and abrasive conditions. Impellers are die-cast bronze, hand finished and balanced. All types of driving arrangements are available: direct-connected electric motor (1 to 10 hp); right-angle geared drive for use with horizontal engines; multiple-V-belt or flat-belt pulley. **Peerless Pump Div, Food Machinery and Chemical Corp, 301 West Ave 26, Los Angeles 31, Calif.**



Selenium Rectifier E528

THIS TANK-TYPE RECTIFIER is made in both oil-and-water-cooled models mounted in steel tanks and ranging in size from 2- to 100-kw. Rectifier water-cooling fins are supplied with thermostatic valves controlling amount of water used in proportion to the load.

Units are suitable in industrial plants and utilities for operation of traveling cranes, hoists, elevators, machine tools and magnetic equipment. When parallel, the load automatically equalizes between any number of units. **Clark Electronic Laboratories, Box 165, Palm Springs, Calif.**

Totally Enclosed Motors E529

INTERNALLY, THESE MOTORS are divided into two isolated parts, with each side having its own path for internal air circulation. Construction makes it simple to keep the motor free of dirt that tends to clog air passages in the conventional type of fan-cooled motors.

Available for 1-D or 2-G locations in ratings of 3600 rpm, 250 to 400 hp; 1800 rpm, 200 to 300 hp; and 1200 rpm, 150 to 200 hp. **Allis-Chalmers Mfg Co, Milwaukee, Wis.**

Hydraulic-Operated Crane E530

DESIGNED FOR ECONOMICALLY HANDLING small jobs on which a conventional crane-excavator would prove too expensive, this hydraulically operated crane handles loads

From Small Schools to Huge Plants . . .

WATER HAMMER is serious

but is so easily eliminated with

THE WILLIAMS-HAGER *flanged* SILENT CHECK **VALVE**

Write for complete information on The Williams-Hager Flanged Silent Check Valve—that has proven successful on the most difficult installations.

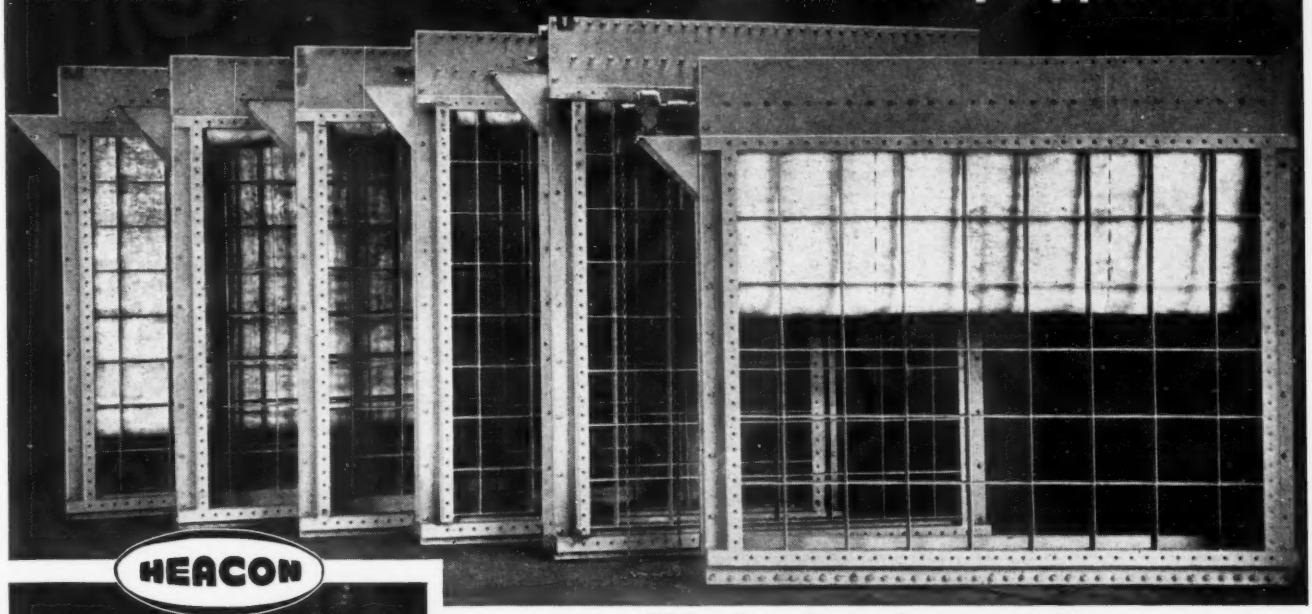
THE WILLIAMS GAUGE CO.

Pump Valves . . . Water Gauges . . . Gauge Cocks . . . Steam Traps . . . Pump Governors . . . Feed Water Regulators . . . Water Columns

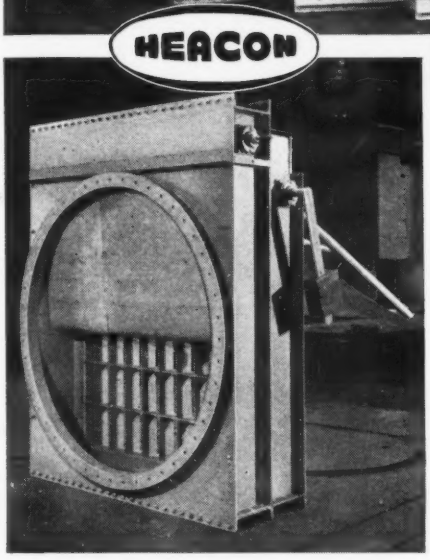
2055 PENNSYLVANIA AVE. · PITTSBURGH (12), PA.

HEACON DAMPERS

- any size
- any shape
- any application



SVH Type Heacon Dampers—for single direction flow.



SVH and LH Combination—SVH Damper regulates flow, LH Damper acts as check valve on reverse flow.

The Heacon Dampers shown on this page cover a wide variety of sizes, shapes and applications, for the control of gases and air.

The basic principle of this unique damper is a flexible curtain that may be constructed of steel, asbestos, rubber or canvas, depending on application. This flexible curtain conforms to the seals, yet permits adequate clearance without the leakage inherent in conventional types.

Flow pressure is not transmitted to the operating spindle as torque-power required for operation is reduced to a minimum. Better Regulation, Increased Capacity, Reduced Maintenance and Lower Banking Losses are a few of the important advantages of Heacon Dampers.

Request Bulletin No. 10 on your company letterhead.

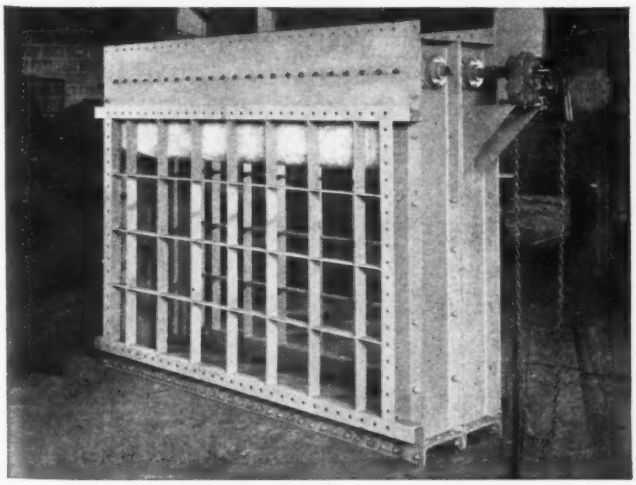
Sales and Project Engineers

THE THERMIX CORPORATION

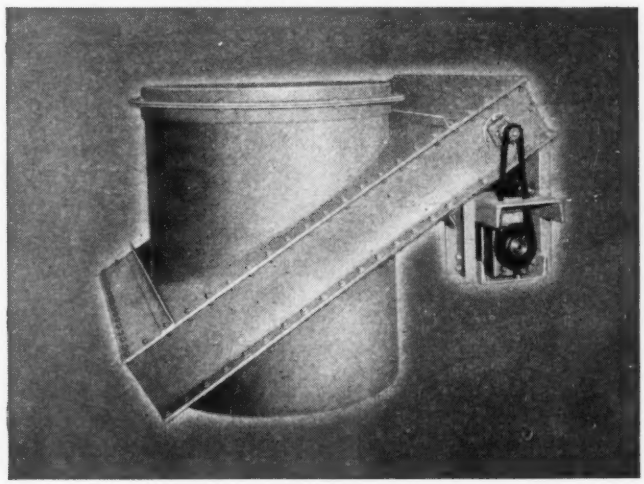
FIRST NATIONAL BANK BLDG., GREENWICH, CONN.

(Offices in 28 principal cities)

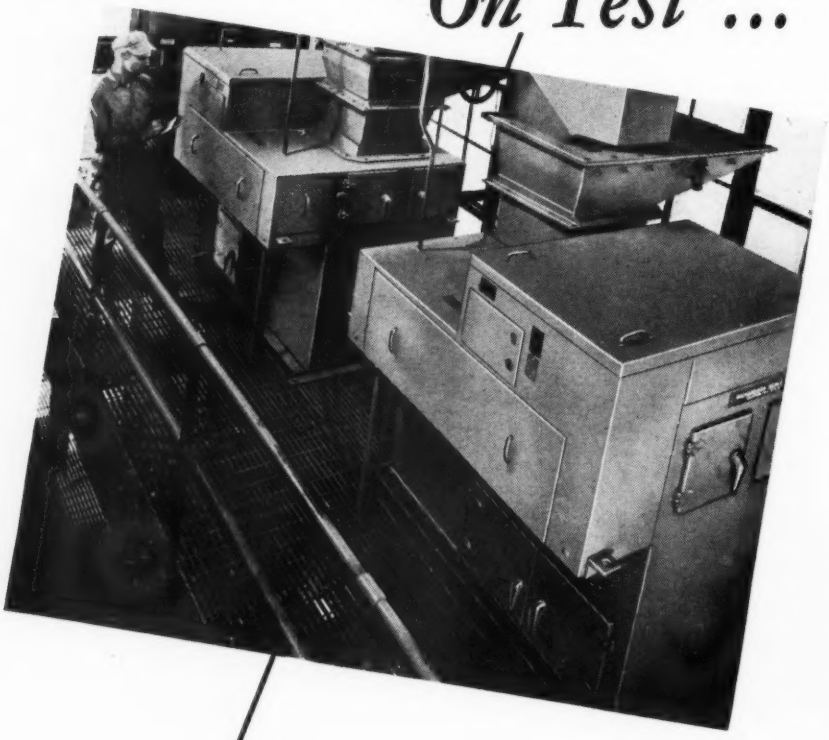
DVHR—for reversing flow, regulates flow in either direction.



SIV—inclined type Damper for vertical duct downward flow.



COAL SCALES KEEP BOILERS "On Test"...



"Richardsons" Do It Best

When a Richardson scale is weighing and feeding your coal you have the most dependable, accurate, automatic equipment that money can buy. Without an equal for year-in, year-out service, every Richardson scale is backed by 60 years' experience designing automatic materials weighing equipment and over 40 years of building coal scales.

Current models will be found even more *rugged, dependable, accurate, dust tight*—than the old units, some of which are still in use after 30 years of service. They do not "hang up" on wet coal or dry—coarse coal or fine—but give accurate records of coal consumed per boiler—by the hour, shift, day, week or month.

Through this continuous service, Richardson has gained a knowledge which has kept pace with the more rigid requirements of present day and future power plants and resulted in constant modernization of equipment each year.

In your district there is a factory-trained Richardson Service Engineer. If your Richardson scale needs a parts or operational check-up, call him in...you will be sure of a thorough, competent and courteous inspection, and worthwhile recommendations for getting maximum efficiency from your boiler plant.

WHILE AT THE POWER SHOW VISIT BOOTHS 385-387

5217

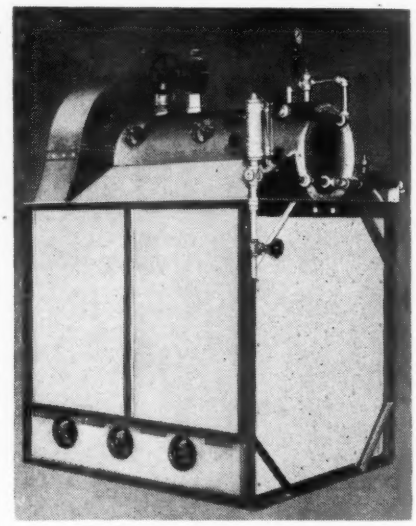
RICHARDSON SCALE COMPANY, Clifton, N. J.

ATLANTA • BOSTON • BUFFALO • CHICAGO • MINNEAPOLIS • WICHITA
NEW YORK • OMAHA • PHILADELPHIA • SAN FRANCISCO • DETROIT • PITTSBURGH • MONTREAL • TORONTO

up to 3 tons. Full hydraulic operation of the crane, which is powered by the truck engine and governor controlled to run at middle of normal speed range, eliminates shafts, drums, gears, clutches, brakes, chains and sprockets. Operation is easy because there is no need of synchronizing hand and foot motions. Factory-mounted on a motor truck, the unit can travel at fast speed from one job to another. Overall length in travel position is 24 ft 6 in. and height 10 ft. 6 in. **Bucyrus-Erie Co, 7923 W Greenfield Ave, Milwaukee 14.**

Voltage Regulator E531

A NEW ELECTRICAL DAMPING SYSTEM, developed for the rocking-contact-torque-type generator voltage regulator, provides increased sensitivity and quick response. The damping mechanism is a separate assembly designed for rear-of-board or remote mounting. No restriction is placed on the regulator to prevent free movement in correcting a voltage change, but damping action does prevent undesirable voltage swings. **Allis-Chalmers Mfg Co, Milwaukee.**



Watertube Boiler E532

MEDIUM CAPACITY, (750 to 3000 lb per hr) 125 psi, bent-tube watertube boiler has a steam drum of 18 in. dia and is from 4 to 6 ft long. Unit employs 1½-in. dia steel tubes, 13 ga with a double row in the waterwall section. Coal, oil or gas may serve as fuel. Standard items supplied are safety valve, steam stop valve, blowoff valves, steam gage, water-column and feedline stop and check valves. **Queen City Engrg Co, 500 St. Johns Pl, Brooklyn, N. Y.**

Chemical-Feed Pump E533

AIR-POWERED PUMP is a positive-metering unit for controlled-volume pumping; provides process control of small liquid volumes down to one pint per hr. Stroke adjustment and liquid-end construction similar to company's standard electrically driven units. A 1-hp rotary air or gas motor, operated at constant speed through a geared speed reducer, drives the pump at rated number of strokes per hr. Motor operates on 50- to 80-psi air. Pumps are

Pioneering Large Plastic Fans for Water Cooling Towers

Another C. H. Wheeler FIRST! Plastic fan blades for the "biggest" cooling towers. The same type plastic fans available for years for smaller C. H. Wheeler cooling towers now can be supplied for large sizes. Scores of users have experienced their superior resistance to corrosion, moisture, and abrasion. Names of installations will be sent on request. . . . What's more, these plastic fans are tested, approved and carry the "Certified Rating" of PFMA (see right). Fan blades have adjustable pitch and a 20-to-1 safety factor at the welded steel hub. Cooling tower catalog on request.

C. H. WHEELER MFG. CO.
1800 Sedgley Avenue, Phila. 32, Pa.
REPRESENTATIVES IN MOST PRINCIPAL CITIES

Plastic Fan Blades Used for Years in Small and Medium Size C. H. Wheeler Water Cooling Towers

now

C. H. Wheeler Introduces Plastic Fan Blades for Large Towers

Certified Ratings
Air Deliveries are in accordance with Standard Test Code for Centrifugal and Axial Fans
MEMBER OF
PFMA

The Propeller Fan Manufacturers' Association was organized early in 1939, and all members are known by the Certified Rating insignia shown above. All fans manufactured by members are tested for air deliveries in accordance with the Standard Test Code for Centrifugal and Axial fans which was adopted jointly by the National Association of Fan Manufacturers and the American Society of Mechanical Engineers, and in 1939 by PFMA.

C. H. Wheeler

STEAM CONDENSERS • WATER COOLING TOWERS
EJECTORS • STEAM JET VACUUM REFRIGERATION
OF PHILADELPHIA

ALLPAX

. . . the UNIVERSAL PACKING

STOPS LEAKS
PREVENTS SCORING
LONG-LIVED

ALLPAX . . . the packing that packs *all* . . . eliminates packing waste and saves time and labor in packing. When worn so that the gland is taken up entirely, it is not necessary to replace with new packing . . . simply back off the gland and add a sufficient amount to fill the stuffing box. This feature of ALLPAX means economy in the use of ALLPAX as there is no waste, *all* of the packing being effective. Furthermore, the repacking job is faster and easier.

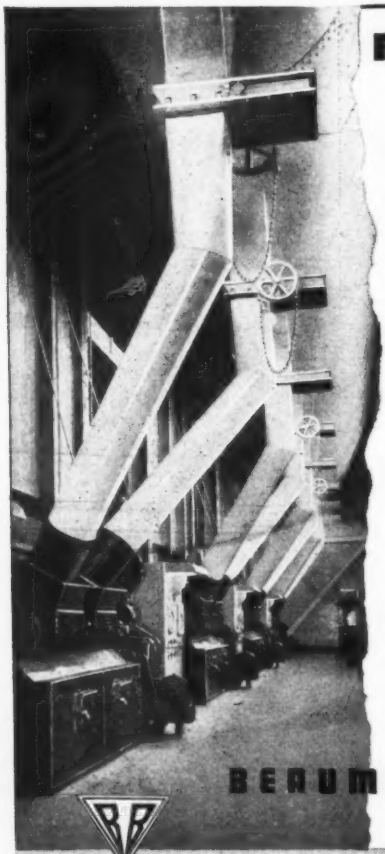
ALLPAX maintains its resiliency over long periods of service, conditions itself to a glassy, non-scratching surface and is guaranteed not to score the shaft.

All the advantages are in a packing that is recommended for hot or cold liquids or gases, and is available for all sizes and shapes of stuffing boxes. Try ALLPAX and see for yourself.

Your distributor can supply you.

THE ALLPAX CO., INC.

MAMARONECK, NEW YORK



FOLLOW THE *Leader*

. . . and INSTALL BEAUMONT ANTI-FRICTION GATES

● Many utilities are replacing their present gates with Beaumont improved anti-friction type gates. Since the first order from one utility in 1942, many repeat orders have been received for installation in this company's other power plants.

In all cases, these gates have given very satisfactory service. According to one user, "No trouble whatever has been experienced opening and closing these gates—and no maintenance has been necessary other than periodic greasing".

Many leading plants throughout the country are finding it economical and time-saving to install Beaumont trouble-free type gates such as those pictured at left. Follow the leaders and do the same. These gates are made in sizes from 14" to 30". Request complete information.

One contract—one responsibility

BEAUMONT BIRCH *Company*

1502 RACE STREET • PHILADELPHIA 2, PA.

Designers Manufacturers Erectors COAL AND ASH HANDLING SYSTEMS

available in any iron, steel or alloy metal that can be cast and machined, also in certain plastic materials. **Milton Roy Co, 1300 E Mermaid Road, Philadelphia 18, Pa.**

Welding Rod E534

LOW-HEAT WELDING ROD is designed specifically for repair service on cast iron or steel worn down by abrasion, impact or corrosion. *Eutechrom* 2, an electrode with a special coating, requires little current and permits use of the "overlaying" technique.

Resulting weld is said to have an extreme hardness of Rockwell C62 (650 Brinell). Rod comes in $\frac{1}{4}$, $\frac{5}{16}$ and $\frac{3}{8}$ in. sizes; its remelt temperature is 2300-2400-F. **Eutectic Welding Alloys Corp, 40 Worth St., New York 13, N. Y.**

Vibration Meter E535

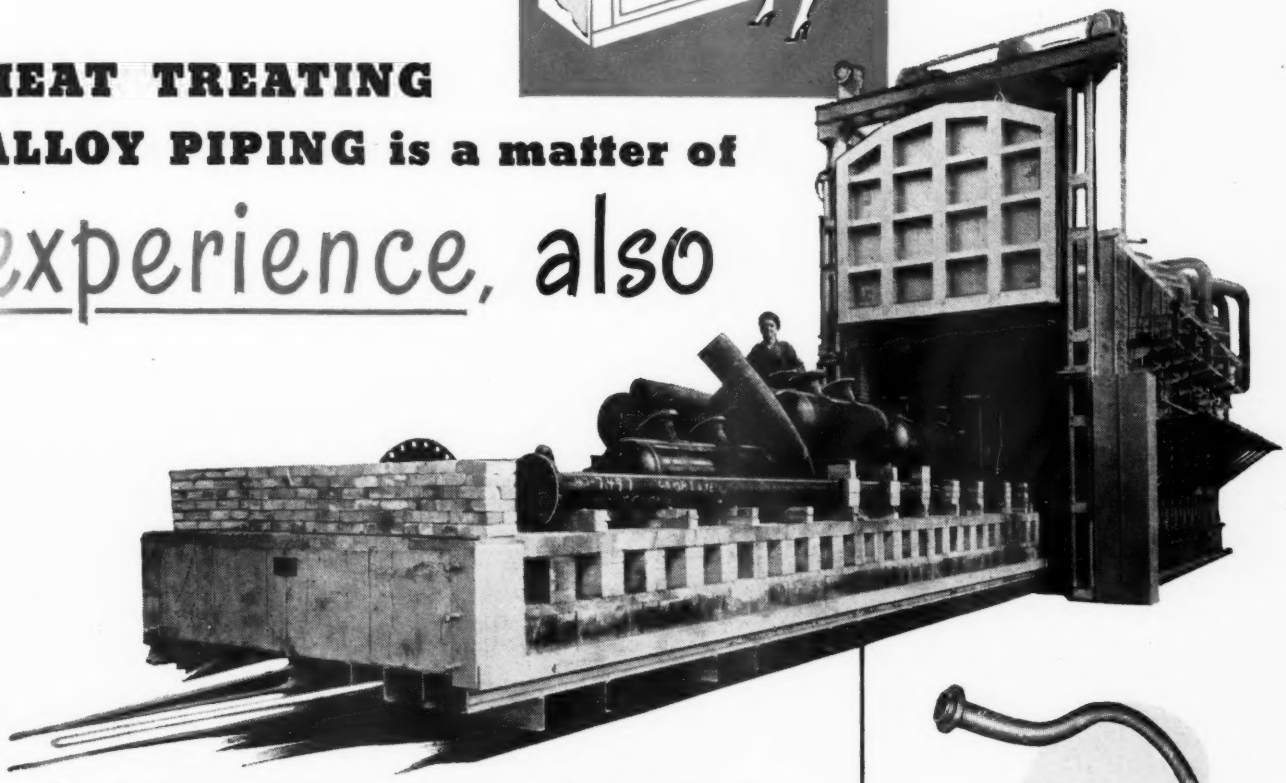
THIS RECORDING VIBROMETER is designed to measure and record frequency, displacement, and wave shape of mechanical vibration. Weighing 7 lb and measuring less than 8 in. in height, the *Vibrometer* is designed to operate either when mounted on a fixed base or held in hand.

It is suitable for testing all reciprocating and rotating machinery within a vibrating frequency range of 10 to 120 cps; records both steady-state and transient vibration. Vibration is transmitted through a prod extending from one side of the *Vibrometer*, which in turn sets a stylus in motion producing an inkless record of the vibration on wax paper. Another stylus produces a timing mark near edge of wax paper every one-third of a second. **General Electric Co, Schenectady 5, N. Y.**

Magnetic Brake E536

SERIES X-60 brake is suitable for 1/6-, $\frac{1}{4}$-, 1/3-, $\frac{1}{2}$-, and $\frac{3}{4}$-hp motor service. Brake housing is a cover for mechanism only and can be removed without disturbing operating parts. Brake operates with straight-line solenoid pull; a lining wear indicator, coupled with ease of adjustment, compensates for lining wear. This frac-

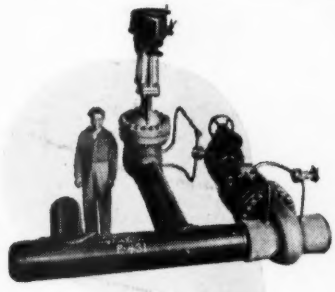
HEAT TREATING ALLOY PIPING is a matter of experience, also



Heat treating alloy piping is as "fussy" as baking a cake. If not done exactly right, quality can be seriously impaired. It takes plenty of experience as well as scientific metallurgical control to heat treat alloy piping.

Stress relieving to remove residual stresses . . . annealing or normalizing for desired grain structure . . . proper heat treatment of alloy piping for maximum strength, toughness, high temperature stability, or maximum corrosion resistance. Method of heating, time, temperature, cycle for heating and cooling, cooling method, etc., must be carefully regulated by experienced men. Too rapid heating or cooling will crack some alloys. Improper heating may create undesirable microstructure, impair physical properties or destroy corrosion resistance. Pitfalls are many.

With the right equipment . . . the scientific metallurgical control . . . and the trained and experienced men, Qualified Pipe Fabricators do heat treating *right*. They produce better piping . . . often save you money in first cost . . . always in the long run.



THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

1108 CLARK BUILDING • PITTSBURGH, PA.

P.F.I. THE PIPE FABRICATION INSTITUTE

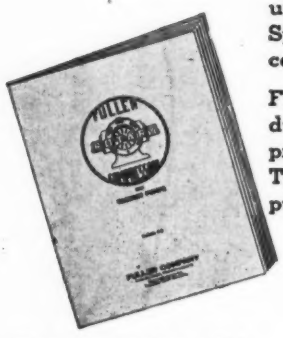
No matter where you put them, Fuller Rotary Compressors do a job, and do it well. This has again been proven by one of the large manufacturing companies in the country . . . the Permanente Cement Company, directed by Henry J. Kaiser.

Two of its installations are shown above:

On land—Two Fuller Rotary Duplex Single-Stage Compressors installed in a cement plant. Each unit has a capacity of 2040 c.f.m., at 40-lb. pressure. These compressors furnish air for a Fuller-Kinyon Conveying System for transporting cement from storage silos to an ocean-going, cement-carrying vessel.

On sea—Three Fuller Rotary Single-stage Compressors, 'tween decks on the bulk cement-carrying vessel. Capacity of each unit 1560 c.f.m., 45-lb. pressure. These units furnish air for the Fuller-Kinyon Conveying Systems installed on board, which transport the bulk cement from ship to storage silos at destination.

Fuller Rotary Compressors are ideal units for any industrial plant, for capacities up to 3300 c.f.m., 125-lb. pressure. Thousands of users will verify this fact. The next time you need compressors, or vacuum pumps, get in touch with us.



Write for Bulletin C-5

FULLER COMPANY
CATASAUQUA—PENNSYLVANIA

Chicago 3 - 120 So. LaSalle St.
San Francisco 4 - 420 Chancery Bldg.

C-176

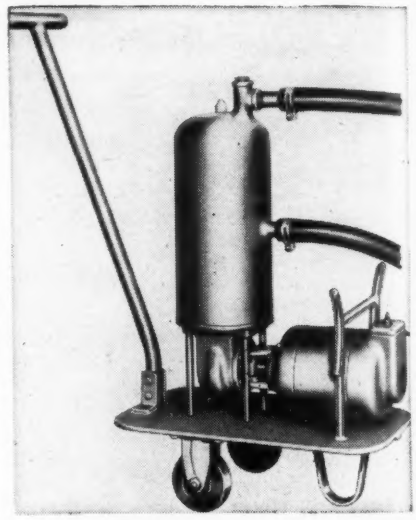
Fuller
A LIFETIME OF NEW MACHINE EFFICIENCY

tional horsepower brake is suitable for continuous or intermittent duty for ac or dc current, and is adaptable for motor or floor mounting. **Stearns Magnetic Mfg Co, Milwaukee 4, Wis.**

Conveyor-Belt Fastener E537

PLATEGRIP BELT FASTENERS pull belt ends together into a smooth, flexible joint. Of heavy-gage steel, they are designed to withstand any load the belt can safely carry. Individually spaced, they permit troughing and make a smooth and flush joint that easily passes under stripper.

Fasteners are available for belts from ¼- to 1½-in. thickness and packaged in sets of ten of a size to a box. **Armstrong-Bray & Co, 5364 N W Highway, Chicago.**



Portable Pump E538

RECENTLY DEVELOPED PUMP is designed for transfer of liquids and for rapid removal of coolants from machine-tool reservoirs to sumps. This unit consists of centrifugal pump with internal discharge features combined with a shell reprime chamber with direct-communicating discharge and inlet. Pump is mounted on a fabricated steel truck with rubber-tired casters for easy movement. **Ruthman Machiney Co, Cincinnati 2, Ohio.**

Safety-Lamp Changer E539

THIS DEVICE may be used for removing broken lamp bases and for changing electric-light bulbs, without using a ladder. Consisting of various-sized rubber heads and light-weight sectional poles, lamp changer operates by sliding rubber changer-head over lamp to be replaced; a couple of twists of the wrist bring the light bulb in or out of socket. The device is thoroughly insulated to eliminate hazard of falls, shocks and burns. **Chadsey Corp, P O Box 1858, Hartford 1, Conn.**

Flexible Couplings E540

MULTIPLE-HP COUPLINGS, rated 2 to 100 hp at 1750 rpm, are available in 17 sizes. Up to 15 hp, couplings have 15-deg torsional deflection under rated load and sizes 30 to 100 hp have 3 deg to give vibration

Are You Tied Down With PIPE *Details?*

Free yourself to go ahead with things only you can do. We have the organization, shop facilities and certainly the experience (48 years) to relieve you of all piping details from preliminary engineering to final completion. High temperature and high pressure, carbon or alloy steel piping—engineered—prefabricated—installed—guaranteed. The repeat contracts we've received prove satisfaction on large and small projects. Ask us about "who we've worked for" . . . and may we send a copy of our bulletin, "Something New in Welding," describing the Mitchell-Westport Joint, which prevents weld metal protrusions inside the pipe, without the use of backing rings.

WESTPORT JOINT

(PATENTED)

W. K. MITCHELL & CO., INC.

2944 ELLSWORTH STREET

PHILADELPHIA 46, PA.

SINCE 1899

Representatives in Boston, New York, Cleveland, Mobile and Havana

MITCHELL

PIPING FABRICATORS AND CONTRACTORS

Zallea Expansion Joints Rate . . .

First Choice!

THE Zallea Stainless Steel Expansion Joint shown above is one of several used in the process steam distribution line of a large Western refinery . . . installed for dependable, economical operation.

In refineries, in power plants, in chemical process plants—throughout industry—Zallea Expansion Joints are rated *first choice* as the ideal medium for absorbing movement in pipe lines due to thermal changes. These features tell why more and more engineers and designers insist on Zallea when they want the best:

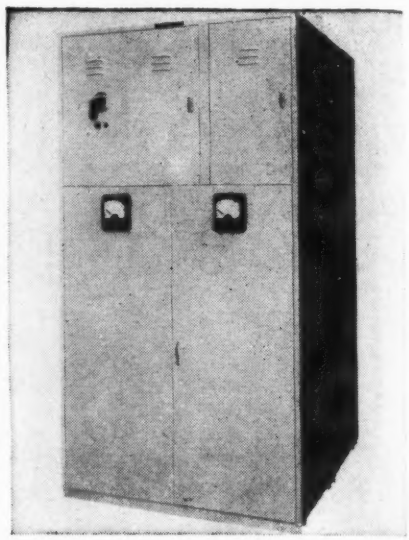
- *More economical than expansion bends*—the cost of insulating and installing a bend alone is frequently more than the cost of a Zallea Expansion Joint.
- *No maintenance*—having no packing they may be used in underground lines without manholes.
- *Low thrust against anchors*—require only 1/10 the force required to compress some slip type expansion joints.
- *An expansion joint for every type of service*—special types for combined axial and lateral movement.
- *Shorter face to face dimensions*—enables installation in close quarters.
- Elements may be made of stainless steels, copper, or any other metal required.
- Hydraulic method of forming assures uniform wall thickness throughout corrugations.
- As easy to install as an ordinary flanged or welding fitting.
- Traverse range from fractions of an inch up to 7½" in a single unit and 15" in a double unit.
- Pressure range from vacuum to 300 lbs. in standard units. Up to 1000 lbs. in special units.
- Temperature range from sub-zero to 1600° F.

Catalog 47 contains complete information on all Zallea Expansion Joints. We would be pleased to send you a copy. Write today! Zallea Brothers, 814 Locust Street, Wilmington 99, Del.

Zallea
EXPANSION JOINTS

WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS EXCLUSIVELY

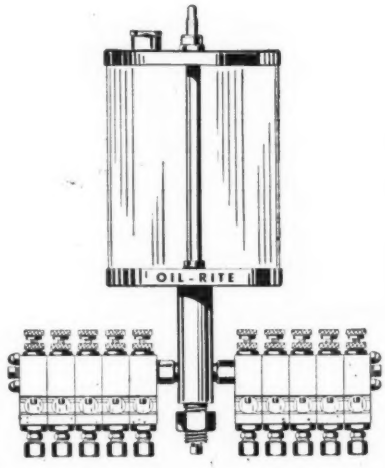
isolation. They accommodate at least 2 deg angular and 1/32 in. parallel misalignment. *Neoprene* flexing elements operate in shear and are bonded to steel plates. Since they have no bearing surfaces to chafe, couplings are permanently quiet, require no lubricant, and are not affected by abrasives. **Lord Mfg. Co, Erie, Pa.**



Motor Controller E541

THESE NEW METAL-ENCLOSED CONTROLLERS regulate squirrel-cage, wound-rotor, synchronous, multispeed ac as well as dc motors. They are suitable for use with pumps, mixers, grinders, mills and similar drives in heavy industries. They are available for ac motors rated up to 800 hp at 550 v and for dc motors up to 350 hp at 230 v.

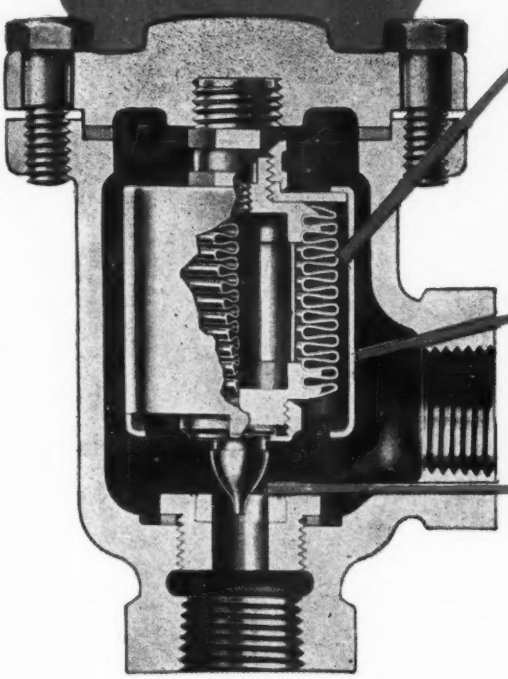
Each unit contains, in addition to the conventional equipment required to start, stop and control such motors, a draw-out air circuit breaker to provide adequate short-circuit protection (either to 25,000 or 50,000 amp). All units are readily interchangeable, hence reducing any production delay for servicing and maintenance. **General Electric Co, Schenectady 5, N. Y.**



Gravity Feed Oiler E542

GIVING STEADY DROP FEED OILING to a number of individual bearings, the Oil-Rite Style *DM* is fed by gravity from a reservoir

AFTER 25 YEARS STILL THE LEADER



SARCO No. 9
THERMOSTATIC STEAM TRAP

Sarco, the pioneer in high pressure thermostatic steam trapping, has maintained its leadership by producing ever better steam traps at ever lower costs. The know-how of designing and producing traps has been supplemented by extensive research with new materials, and constant additions of new machinery especially designed for us. And withall, every installation of the hundreds of thousands of these traps has added to the application data which is in the hands of every Sarco Representative.

FOR THESE VERY GOOD REASONS:

FAST ACTION Sarco No. 9 traps are filled to open at 10° F. below steam temperature. Wide open when cold, quick starts are assured. They are fast as well as efficient.

THE SARCO PHOSPHOR BRONZE BELLOWS is made in our own plant. We deep-draw the tubing from phosphor bronze blanks and corrugate it helically on special machines developed by us.

The result is a heavy wall bellows with extra strength to withstand unbalanced pressures, as on starting from cold. The end closures are brazed (not soldered) by the latest electronic induction methods. (Stainless steel bellows for corrosive condensate or superheat also are available.)

THE PATENTED SHIELD The shield which protects the bellows from abrasive action of the steam extends over the entire length of the bellows and forms a part of the element. Prongs at the end prevent over-expansion should the element be removed from the trap body while hot.

VALVE HEAD AND SEAT are of 18/8 stainless steel and renewable. The parabolic head is self-aligning to assure tight shut-off. Its shape secures maximum trap capacity with minimum valve lift.

REAL CAPACITIES ARE LARGE Sarco No. 9 uses a different diameter bellows for every trap size (except half inch). The 2" trap has a bellows 2⅜" o.d. It is the bellows area which determines the size of the valve orifice that can be used, and therefore the actual capacity.

TEST BEFORE YOU BUY. These features are vital to the trap user. They mean efficient condensate removal and long life with minimum maintenance costs.

Thousands of satisfactory installations prove the above statements. However, if you wish to make your own tests, we shall be glad to place at your disposal one or more traps of any desired size subject to return for full credit if they do not measure up to your requirements.

Full information in Catalog No. 250.

250

SARCO
SAVES STEAM

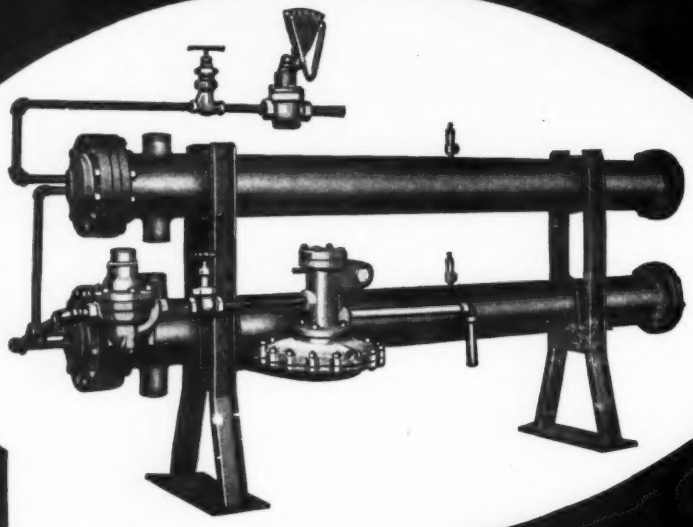
SARCO COMPANY, INC.
Represented in Principal Cities
Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 5, ONTARIO

$ $ $ Save WITH HENSZEY CONTINUOUS BLOWDOWN

SAVE EQUIPMENT—The Henszey Blowdown System prevents priming, foaming and carryover . . . and also prevents the formation of scale by simple chemical treatment of the feed water. Boilers last longer and tube burns are kept at a minimum. The resultant clean steam makes packings last longer — reduces wear on rods and cylinders —reduces turbine blade erosion — prevents sticking of reducing valves, traps, etc. — prevents superheater burnouts.

SAVE MANPOWER — The Henszey System is completely automatic. Boiler shut-downs and repairs are reduced to a minimum. No man hours lost unnecessarily replacing packings, repairing or replacing rods and cylinder rings, turbine nozzles, turbine blades, valves and other equipment along the line.

SAVE FUEL — The Henszey System offers complete, automatic blowdown without heat loss — a big fuel saving in itself. Then, too, boilers free from scale and sludge are more efficient — they require less fuel to produce the power load.



- Produces clean steam — no carry-over.
- Saves up to 95% of the heat loss of ordinary intermittent blowdown.
- Prevents Priming and Foaming.
- Prevents Scale (with simple chemical treatment).
- Automatically Controls Boiler Water Concentration.
- Indicates and Meters Blowdown.
- Practical for any size plant — large or small.

HENSZEY COMPANY
Dept. D12, Watertown, Wis.

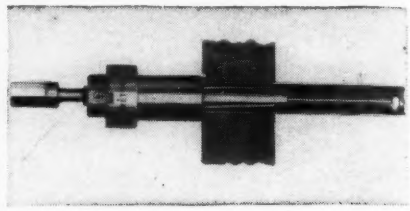
HENSZEY

CONTINUOUS BLOWDOWN

Boiler Feed Regulators • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PREHEATERS

through multiple, gang-mounted, sight-feed valves. One oiler may replace two to 24 individual units in addition to offering many advantages through a central method of lubrication.

Reservoir is usually of *Lucite;* for applications where temperature exceeds 150 F, glass reservoir and sights are available. Standard models come in five body sizes with capacities from nine oz to one gal and up to 24 feeds. These oilers are suitable for use with machine tools, punch presses, printing presses, conveyors, etc. **Oil-Rite Corp, 3417 S 13th St, Milwaukee 7, Wis.**



Tube Expanders E543

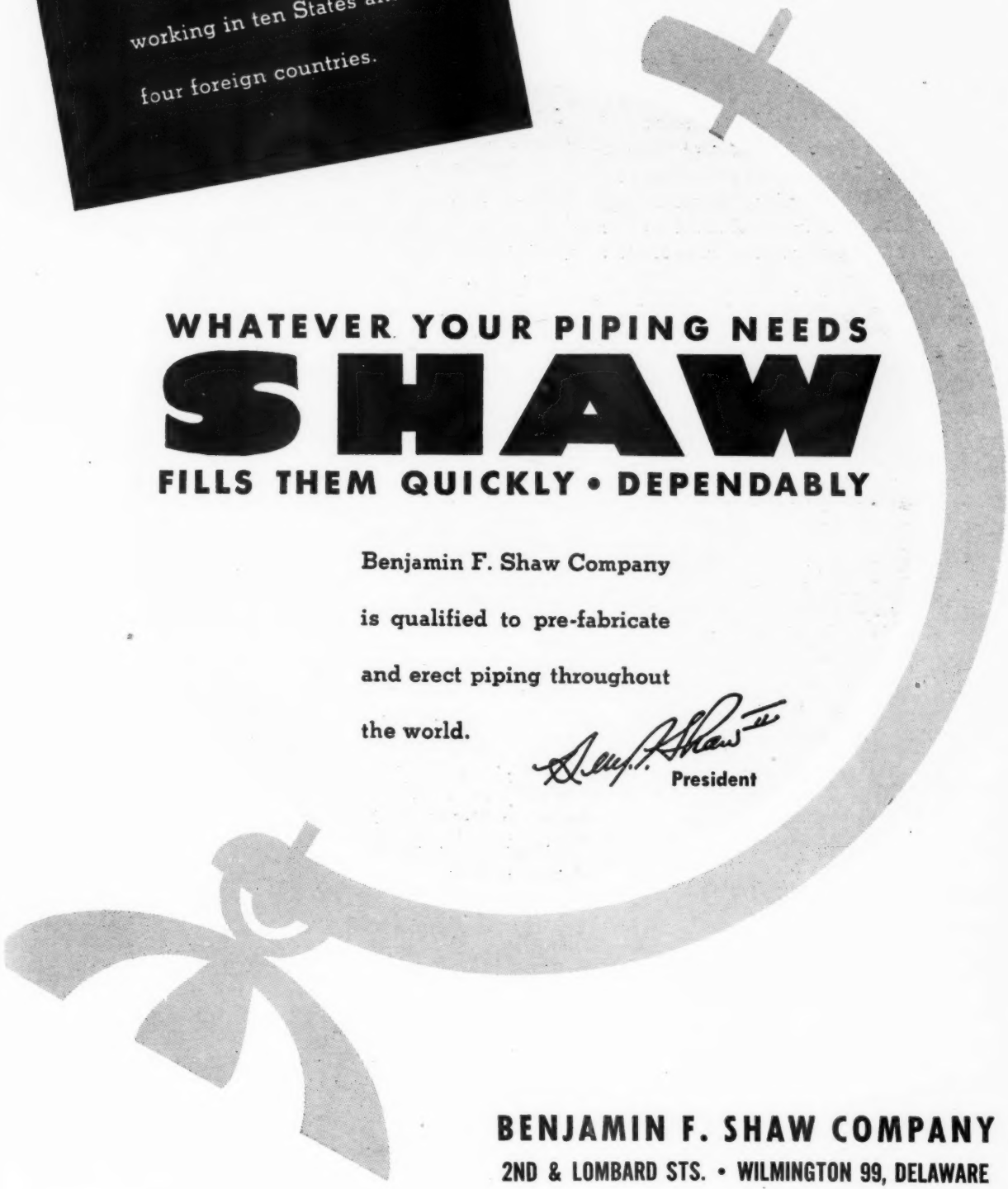
G-800 AND G-1200 self-feeding tube expanders have ball-thrust bearings for precision rolling of heat-exchanger tubes ½ to 1½ in. OD. The heat-treated rolls are tapered to produce uniform expansion and tightening of the tube throughout tube-sheet thickness. Photo shows G-800 expander with 2¼-in. rolls as used in a thick tube sheet. Rolls are available to handle from ½ to 2¼-in. tube sheets. The G-1200 tool can handle tube sheets from 1½ to 6¾ in. **Airetool Mfg. Co, Springfield, Ohio.**

Magnetic Starter E544

THESE NEWLY DESIGNED STARTERS fulfill NEC requirements for motor-branch circuit overcurrent protection, disconnect means, motor-running overcurrent device and motor controller. Bulletin 4130 ac combination magnetic starter with circuit breaker consists essentially of a magnetically operated contactor with thermal inverse-time-delay overload relays, combined with a thermal-type circuit breaker.

. All circuit breakers are externally operated and have provision for padlocking in

The Shaw Company has a total of 3,000 employees working in ten States and in four foreign countries.



WHATEVER YOUR PIPING NEEDS

SHAW

FILLS THEM QUICKLY • DEPENDABLY

Benjamin F. Shaw Company is qualified to pre-fabricate and erect piping throughout the world.

President

BENJAMIN F. SHAW COMPANY

2ND & LOMBARD STS. • WILMINGTON 99, DELAWARE

KNOWN SINCE 1893 FOR HIGH-QUALITY PIPING PRE-FABRICATION AND INSTALLATION

4 REASONS DARTS DON'T DRIP

1. **EVERY DART . . .** is precision-machined to a true ball joint . . . then spherically ground to give wide, true-bearing surfaces. Reason why Darts fit snugly without excessive wrenching . . . are always leakproof.

2. **EXTRA-WIDE BRONZE SEATS . . .** resist pitting, electrolysis and corrosion . . . stay drop-tight.

3. **EXTRA-HEAVY SHOULDERS . . .** shrug off wrench abuse through dozens of installations.

4. **PRACTICALLY INDESTRUCTIBLE . . .** body and nut of air-refined, high test malleable iron resists stress, stretching and wrenching . . . ensures that connections will stay tight.

See your supplier today about these outstanding, money-saving features of Dart Unions.

E. M. DART MANUFACTURING CO.
PROVIDENCE 5, RHODE ISLAND

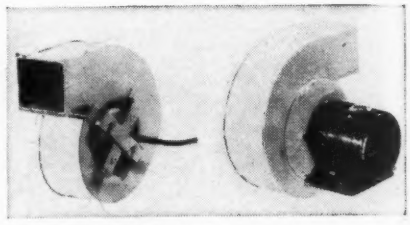
DART UNIONS

the "off" position. They are mechanically interlocked to prevent opening enclosure door when breaker is on. Starters are available in five standard sizes to maximum of 200 hp, 3 phase, 550 v, 60 cycles. **Ward Leonard Electric Co, Mt. Vernon, N. Y.**

Mercury Relay E545

DESIGNED TO CARRY up to 35 amp, this relay incorporates a free-floating magnetic plunger, assuring smooth, silent operation. Heavy tungsten contacts with mercury-to-mercury make and break are hermetically sealed for dust and moistureproof operation. Since there is no exposed arc, the relay may serve under all operating conditions.

Available in 2- and 3-pole units, the relay measures 4 in. in height, $2\frac{5}{8}$ in. in width, and $2\frac{1}{4}$ in. depth. **Ebert Engrg & Mfg Co, 185-09 Jamaica Ave, L. I., N. Y.**



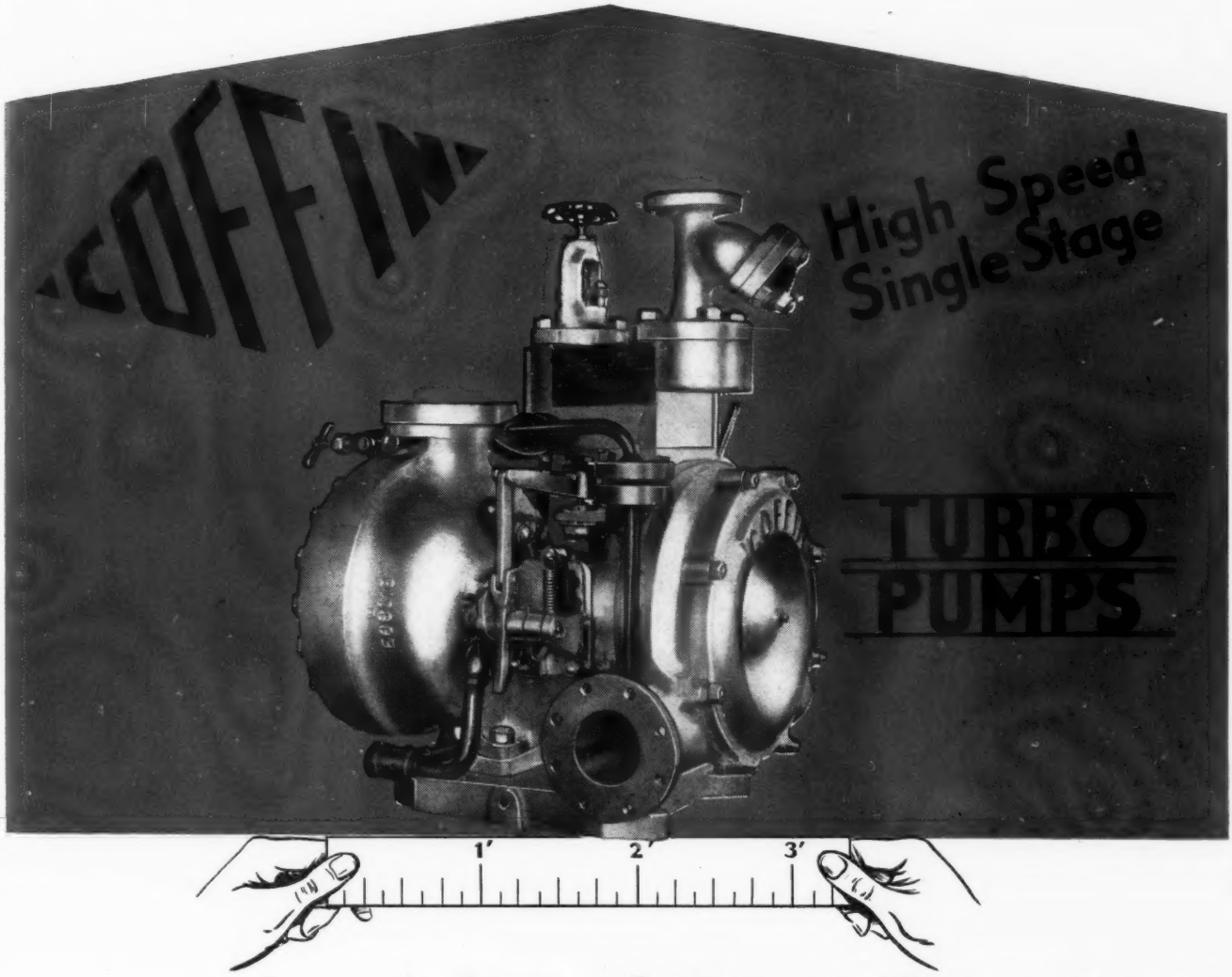
Centrifugal Fans E546

SMALL, 5-in.-dia centrifugal fans are produced in single- or double-width types. Type *5CB* comes in a range of capacities and serves as a cooling means for electrical and electronic equipment as well as a pressurizing system for equipment cabinets. **Johnson Fan & Blower Corp, 1319 W Lake St, Chicago 7, Ill.**

Distribution Transformer E547

TWO TYPES of single- and 3-phase dry distribution transformers are designed to provide specific voltages for auxiliary lighting and power circuits. Single-phase Type *AE* ranges from 250 va to 200 kva and 3-phase Type *AP* from 3 to 300 kva in the 600-v class and below. Dry-type autotransformers are built as single-phase Type *AA* from 500 va to 25 kva, and 3-phase Type *AM* in ranges from 5 to 50 kva. Both types are suitable for 240 to 240/120 v.

These transformers may be used to insulate a lighting from a power circuit or to obtain a 240/120-v, 3-wire circuit from



A Lot of Pump Capacity in Very Small Space . . . . . .

See for yourself at the Power Show

You'll have an opportunity to visualize the compactness of Coffin Turbo Pumps at the Power Show (Booth No. 222). Ask our engineers in attendance to give you the capacities and exact dimensions of Coffin Pumps . . . to show you the details of design and construction . . . to cover such important points as the reasons why these single stage, high speed units are long-lived, highly efficient and low in maintenance and steam consumption.

By engineering a turbine and pump unit into an integral design, Coffin has definitely attained high capacity at a considerable saving in space. Furthermore, full responsibilty for overall performance is placed with *one* manufacturer.

Ask for literature; submit operating data for recommendations by our engineers. No obligation is incurred.

Representatives in Principal Cities

BOOTH NO. 222

Specifications

Steam Pressures....to 650 PSI.
Steam Temperatures..to 850 F.
Back Pressures..... to 60 PSI.
Pump Capacities ..to 500 GPM
Discharge Pressures to 750 PSI. (Heads to 1800 ft.)
Liquid Temperatures..to 300 F

See our catalog in Sweet's Power Plant and Engineering Files.

Also A.S.M.E. Catalog and Thomas' Register

INDUSTRIAL RAILROAD COFFIN MARINE PRODUCTS FOUNDED 1925

The J.S.COFFIN, JR., CO. 326 South Dean St. ENGLEWOOD, N.J.

CRYER Performance Makes Satisfied Users!

Delivery from Stock

Sizes: ½" to 2½"
Capacities: 500 to 38,000# water
Pressures: to 250#

Small wonder Cryer users are enthusiastic boosters. They speak from experience when they report the following:

... 'they really operate.'
... 'cleaned only two or three times in about three years' service.'
... 'they're accessible.'
... 'there has never been any sticking.'
... 'lightness of Cryers make them easy to hook-up.'

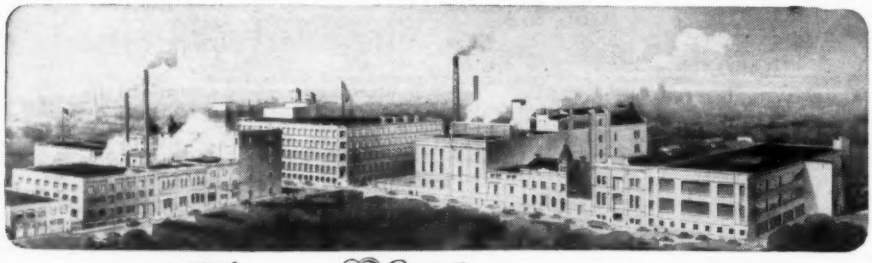
No. 20 (½" Junior Trap)

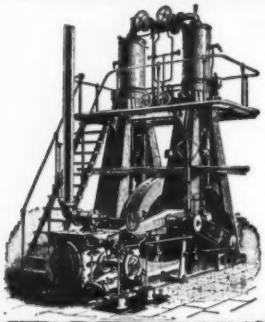
These small compact units, for applications such as unit heaters, laundries, processing kettles, dairies, etc., offer all the outstanding features which have won such wide acceptance for larger size Cryer Traps. Weight is only 5# and installation can be made without supports.

Cryer also makes Thermostatic Radiator Traps as well as all sizes of traps and repair parts for the line formerly known as the J-M Ball Steam Trap.

Cryer Traps are available through leading distributors everywhere.

CRYER TRAP & VALVE CO., INC.
366 Madison Ave., New York 17, N. Y.
Manufacturers of steam specialties for over forty years.

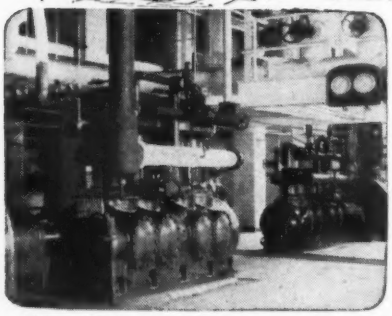




Hudepohl BREWERIES USE FRICK Refrigeration

60 YEARS!

Frick ammonia compressors, as built in the Eighties and Nineties, were primitive machines by today's standards. But they were remarkably dependable: one of those installed in the Hudepohl Breweries at Cincinnati ran 57 years, another 52, and two others 45!



Old and New Types of Frick Machines at Hudepohl's

Naturally, Hudepohls believe in Frick Refrigeration. Their fine new engine room contains the two big Frick 4-cylinder machines illustrated.

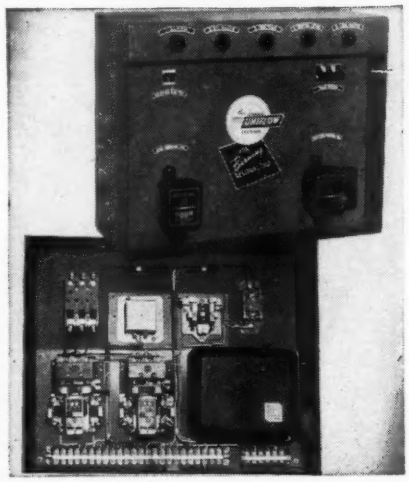
You'll get the last word in reliability when you specify Frick Refrigeration. And you'll get equipment built to handle either ammonia, Freon, methyl chloride or carbon dioxide, to suit your special needs. All commercial and industrial sizes, 1/4 to 1000 horsepower. Let us quote on your requirements. Frick Branch Offices and Distributors are in principal cities everywhere.

DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA. U.S.A.

a 2-wire system. They may also be used to operate low-voltage portable lamps, supplying machine-tool lighting from the motor circuit in addition to feeding portable tools. **Wagner Electric Corp, 6400 Plymouth Ave, St. Louis 14, Mo.**

Motorgear Reducer E548

UNIT COMBINES axial air-gap induction motor with gear speed reducer. It is available in sizes from ¾ to 10 hp. Motor may be removed from gear housing and run separately. It uses two ratios of single helical gears arranged in a simple gear train. Motor and gear shafts are parallel with center line of motor coinciding with that of low-speed gear shaft. Motor has ball bearings and gear shafts have tapered roller bearings. The high-speed pinion is mounted on motor shaft extension close to a double-row ball bearing to reduce shaft deflection to a negligible amount. Bearings on low-speed shaft are oversize to allow for outboard pull from sprocket gear or pulley. Motorgear suitable for horizontal mounting on a level floor, but provisions can be made for wall, ceiling or angle mounting if shaft remains horizontal. **Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago 5, Ill.**



Oil Panelboard E549

PREWIRED, prefabricated control board for industrial oil-burners speeds up new installations, says the manufacturer. All that needs be done is to supply power and connect up. A system of red and green pilot

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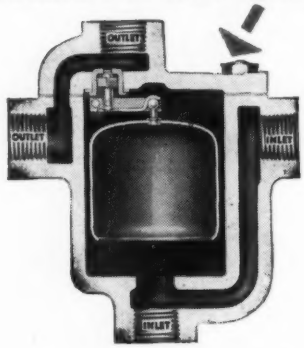
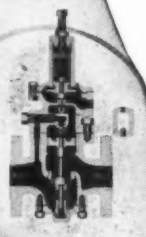
Clark Traps

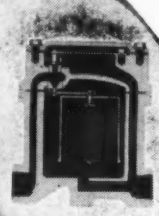
INTRODUCING THE NEW CLARK "60"



Series "80" Inverted Bucket Steam Trap



"CRV" Pressure Regulator



A small trap with big trap features. Positive seating with guided disc. Equipped with *two inlets* and *two outlets* for easy installation for horizontal, vertical or angle connections.

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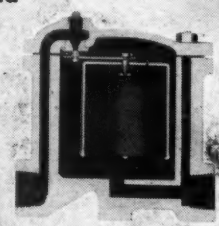

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Series "70" Inverted Bucket Steam Trap

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TRAPS — FLOAT, INVERTED BUCKET, OPEN BUCKET AND VACUUM • REDUCING VALVES • STRAINERS

lights helps the operator to see at a glance if burner is operating. Circuit breakers protect control circuits. **Ace Engrg Co, Chicago, Ill.**

Gear Speed Reducer E550

FEATURING HEAVIER GEARING for increased power for a given size, this speed reducer has worm made integral with its shaft. Larger shafts permit greater loads and a one-piece housing provides large area for heat radiation. Improved oil seals keep oil leakage low and reduce friction on the shaft. Vent valve in filler plug permits unit to breathe while keeping out dirt. **Boston Gear Works, Quincy 71, Mass.**

Nickel Electrode E551

MACHINABLE WELDS, on cast iron without preheating of the metal, can be made, according to the manufacturer, with *Nickelcast*, a 100% nickel electrode, free from fluorides. Welds are machinable both in the deposit and line of fusion and may be drilled, tapped or machined at any point in the weld zone. Electrodes, for either ac or dc, are available in 3/32, ⅛, 5/32 and 3/16 in. dia. **Hobart Brothers Co, Hobart Square, Troy, Ohio.**

Enclosed Worm Gears E552

SMALLER THAN CONVENTIONAL worm-gear drives of equal power, these enclosed designs are suited to horizontal or vertical operation. Increased thermal capacity is obtained by surrounding the oil reservoir with an air channel cylinder through which passes a high-velocity stream of air. Carbon lapped rings seal against leakage. Worm gears are available in a wide range of standard ratios to meet practically any need. **Foote Bros Gear and Machine Corp, 4545 S Western Blvd, Chicago, Ill.**

Fluorescent Lamp E553

USING KRYPTON GAS, this 25-watt fluorescent lamp offers a 15% saving in current cost for the same amount of light. Transformer cost is eliminated, in addition to lengthened lamp life because of lower-starting voltages.

This lamp provides 1400 lumen output as compared to 960 for standard fluorescent lamps of the 20-watt size. Each lamp has a 1½-in.-diameter tube, whose length is 33 in. **Duro Test Corp, North Bergen, N. J.**

Bronze Electrode E554

METALLIC ARC WELDING of copper, tin bronze, brass, cast and malleable iron, galvanized iron, can be accomplished, says the maker, with a phospher-bronze electrode. Welds are said to have a tensile strength of more than 40,000 psi and a Brinell hardness of 70-80. No. 22 Phosphor Bronze "*A*" electrode is available in 3/32, ⅛, 5/32 and 3/16 in. sizes. **All-State Welding Alloys, Inc, White Plains, N. Y.**

ALLIS-CHALMERS

"Certified" Service

A BREAKDOWN on this 39-year-old Allis-Chalmers fan motor crippled operations at the plant of an important midwest electric utility. Immediate repair was vital. The Chief Engineer called the nearest Allis-Chalmers Certified Service shop. They picked up the rotor and returned it ready for service in less than twenty-four hours.

This is the kind of emergency cooperation you can expect from every Allis-Chalmers Certified Service shop. On everyday repairs and maintenance too, your Allis-Chalmers Certified Service shop will give you prompt service on Allis-Chalmers motors, pumps and transformers, using factory approved methods and parts. Every Allis-Chalmers Certified Service shop has been selected for skilled, personal, careful workmanship, adequate equipment and *service mindedness.*

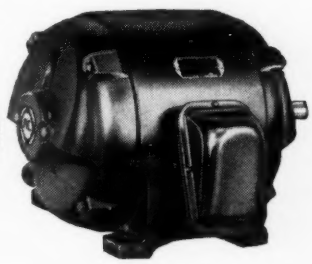
HOW TO FIND NEAREST SERVICE SHOP

Allis-Chalmers Certified Service shops are located in major industrial centers throughout the country. New shops are being appointed continuously and most smaller centers will soon be covered. To find the shop nearest you, call your closest Allis-Chalmers District Office.

A 2543

MOTOR DELIVERIES GREATLY IMPROVED

Many types of Allis-Chalmers Motors are now in stock! Many other types are available on short delivery! For motors from 1 to 200 HP, check your nearest Allis-Chalmers Authorized Dealer. For motors larger than 200 HP, check with the nearest District Office. You may be able to get what you need sooner than you think.



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New Condenser Cuts Refrigeration Costs Saves Cooling Water

● The Niagara Aeropass Condenser cuts the cost of refrigeration by running compressors at lower head pressure, saving up to 35% of power. It uses no cooling water.

The refrigerant gas passes thru two coils in an air stream. The first, "Duo-Pass" dry coil, removes the super heat by air cooling and condenses oil vapor. The second, condensing coil, drenched by recirculated water spray, condenses by evaporation, transferring to the air 1,000 BTU for every pound of water evaporated. This done at low temperature, no scale forms on condenser tubes to clog air passage.

Between the two coils is the "Oilout", which purges the system of crankcase oil and dirt, keeps it always at full capacity.

The "Balanced Wet Bulb" control holds head pressure at the practical minimum. It automatically proportions the fresh air stream to the condensing load with the full benefit of power-saving on cool days, providing full capacity for peak loads.

Niagara Aeropass design results from over fifteen years' experience condensing by air. It is completely trustworthy for year 'round operation. Users say, "It saves half the difficulties and labor of running a refrigeration plant."

Units range from 10 to 100 tons capacity. For full information ask for Bulletin 103.

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INDUSTRIAL COOLING HEATING • DRYING

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Power News

(*Continued from page* 156)

depend, as in the 1948 estimate, on influence of world conditions on this country's industrial index.

At the end of 1946 the total generating capacity of the electrical industry in the United States was 50,316,621 kw. Additions already made and scheduled for the 5-year period 1947-1951, inclusive, amount to 25,300,000 kw—a 50% increase over 1946 in capacity, an expansion far exceeding that for any other major industry in the same period.

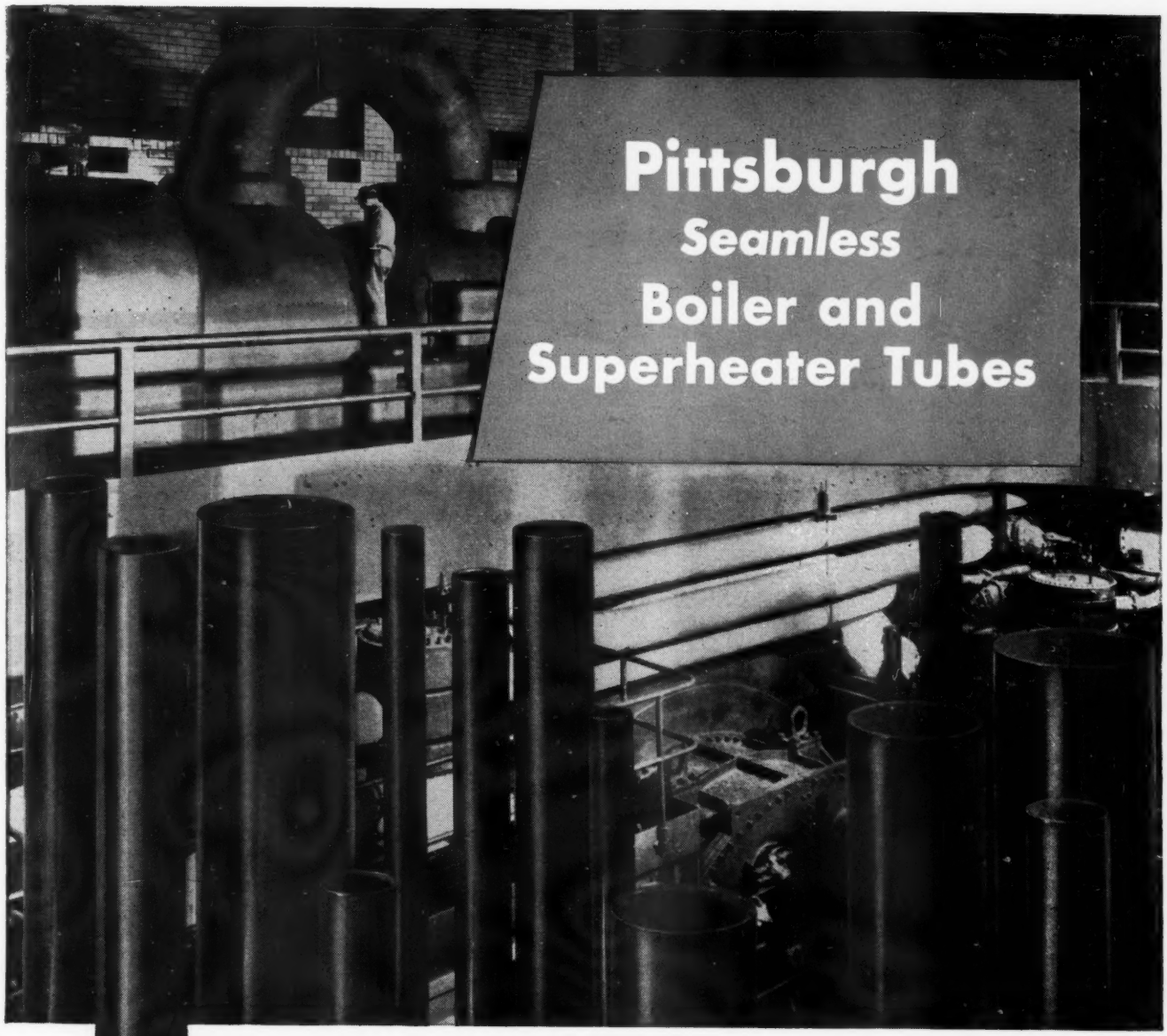
Of the total amount of new installations, 20,900,000 kw will be added by the business-managed, privately owned companies and 4,400,000 kw by governmental power agencies and municipal plants. Steam power-plant installations will account for 83% of the total additions.

Important factors contributing to the unprecedented increase in demand for electrical service are the addition of 6,000,000 new customers since V-J Day —an increase of 18% over total accumulated in previous 63 years of the industry's growth. The backlog of postwar customers awaiting service, however, has been substantially eliminated, and rate of increase in total customers is beginning to slacken.

Gain Factors. European recovery needs, increased attention to defense requirements, and their collateral effect of stimulating civilian production have brought gains in use of electricity in industry. Using 1939 as 100, index figures show that for August 1948, industrial consumption of electricity stood at 213 and manhours of manufacturing at 170. This compares with December 1947 index figures of 196 for industrial electricity consumption and the same figure of 170 for manhours in manufacturing. The high cost of labor and relatively cheap cost of electricity is another big factor in greater electrification.

Says Mr Acker, "The electrical industry since the close of the war has done a remarkable job in the face of extraordinary load growth in catching up on the installation of new generating capacity which was so seriously interrupted during the war."

He notes, however, that with conditions imposed by lower-than-normal reserve generating capacity it may happen, as it did in a few instances last year, that a combination of bad weather and equipment outage coinciding with hours of peak demand may necessitate



Many operators find the long service and ease of installation of Pittsburgh Seamless Boiler Tubes give them *extra* economy in their boiler and superheater units. The carefully controlled chemical and physical properties and the wall strength inherent with seamless tubes give you trouble-free installation and long satisfactory service. Pittsburgh Seamless Boiler Tubes are produced in carbon and alloy grades. Pittsburgh Steel Company, 3270 Grant Building, Pittsburgh 30, Pa.

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Pittsburgh Steel Company

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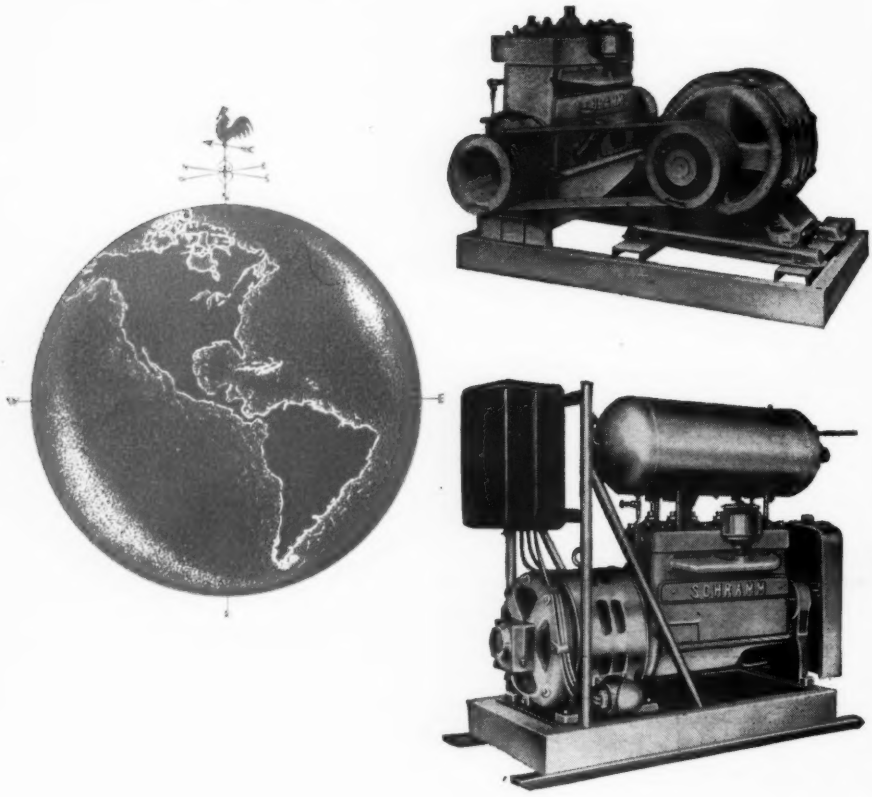

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The check list (at right) indicates some of the many compressed air jobs to be done, all of which are accomplished easily, quickly and economically with Schramm Air Compressors.

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- Operating Drop Hammers
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- Operating Precision Measuring Devices

SCHRAMM INC.

THE COMPRESSOR PEOPLE • WEST CHESTER • PENNSYLVANIA

202 (812b)

some load shifting by industrial establishments of off-peak hours, some appeals to commercial and residential customers for conservation of electricity, and even some curtailment during the period of such emergencies. Shortage of water for hydroelectric generation, because of severe drought, is an adverse factor now in north central and northeastern parts of the United States.

Gas-Turbine Versus Diesel Locomotive

Dr John T Rettaliata, dean of engineering at Illinois Institute of Technology, delivered an address on Sept 24 at the annual Indiana Coal Conference in Terre Haute, Ind., sponsored by Indiana Coal Preparation Utilization Society and Ohio Valley Section of American Institute of Mining and Metallurgical Engineers. He stated that the coal-burning gas-turbine locomotive is the most serious competitor to the diesel locomotive that has yet appeared. It is believed that the gas turbine, especially when using coal as a fuel, possesses more beneficial characteristics, and it is predicted that only by its adoption will the ultimate in locomotive design be achieved.

A 4000-hp coal-burning locomotive gas turbine now being constructed will soon be ready for testing, and if the anticipated performance is realized, fuel and maintenance costs will be lower than for any locomotive ever built. A dc type of electric transmission, similar to that in diesel-electric locomotives, will be employed.

The gas-turbine power plant consists of a 1300-F turbine driving a compressor directly and also, through a reduction gear, a generator. The latter furnishes electric power to traction motors mounted on the axles of the locomotive. A heat exchanger will be used for improved economy.

The expected fuel cost, when using coal, will be about one half that of a diesel locomotive of similar horsepower. Lubrication costs should not exceed one tenth of those of the diesel type. The purely rotary motion of the gas turbine will result in minimum maintenance and vibration.

Besides reducing fuel costs, there are other incentives for using coal. For instance, some railroads get their chief source of revenue from hauling coal, and good customer relations are important. For conservation, use of coal is also dictated.

Rettaliata mentioned that since no water is required for operation, the gas-turbine cycle should be particularly attractive for locomotive installations. Also, elimination of the new necessary water-treating provisions for both diesel and steam locomotives should certainly be desirable.

The second power house completed on the Malad River, Idaho, has been placed on the lines this year. The new plant has a capacity of 13,500 kw and is the third of Idaho Power Co's postwar hydroelectric developments to be finished.

NEW EQUIPMENT and TECHNICAL LITERATURE

Use the handy FREE service cards for additional information on this month's new products or for copies of latest trade catalogs.

NEW PRODUCTS & MATERIALS

See pages 142-146, 176-198

Explosionproof Motor .....page 142
Return-Line Treatment .....page 142
High-Pressure Valves .....page 142
Chemical Gage .....page 142
Space Heater .....page 142
Diesel Engine .....page 142
Oil-Well Motor .....page 144
All Weather Turbine .....page 144
Overfire-Jet Control .....page 144
Shielded-Arc Electrodes .....page 144
Synchronizing System .....page 144
Boiler-Return .....page 144
Hydro-Sheave Drive .....page 144
Jet Pump .....page 146
All-Steel Motoreducer .....page 146
Arc Welders .....page 146
Steel-Gate Valves .....page 146
Steam Trap .....page 146
Diesel Generator Sets.....page 146
Variable-Speed Transmission .....page 146
Hot-Water Generator .....page 176
Nonferrous Electrode .....page 176
Solenoid Valve .....page 176
Multi-Pen Recorder .....page 178
Air Conditioner .....page 178
Thermometer .....page 180
Small Steam Trap.....page 180
Turbine Pump .....page 180
Selenium Rectifier .....page 182
Totally Enclosed Motors.....page 182
Hydraulic-Operated Crane .....page 182
Voltage Regulator .....page 184
Watertube Boiler .....page 184
Chemical-Feed Pump .....page 184
Welding Rod .....page 186
Vibration Meter .....page 186
Magnetic Brake .....page 186
Conveyor-Belt Fastener .....page 188
Portable Pump .....page 188
Safety-Lamp Changer .....page 188
Flexible Couplings .....page 188
Motor Controller .....page 190
Gravity Feed Oiler .....page 190
Tube Expanders .....page 192
Magnetic Starter .....page 192
Mercury Relay .....page 194
Centrifugal Fans .....page 194
Distribution Transformer .....page 194
Motorgear Reducer .....page 196
Oil Panelboard .....page 196
Gear Speed Reducer .....page 198
Nickel Electrodes .....page 198
Enclosed Worm Gears .....page 198
Fluorescent Lamp .....page 198

(Turn over for bulletin items)

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Be sure to fill out, completely, one coupon for each item of information you order. (See sample, right.) This gives your request authority and helps the manufacturer to address your copy completely.

When you have filled out completely one space for each item of information you want, detach along the scored lines and drop the cards in the mail.

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MANUFACTURERS' BULLETINS

See this page and pages 204-208

Bronze Electrode .....page 198
Boilers and Auxiliaries .....page 202b
Electrical Equipment .....page 202b
Maintenance and Safety Eqsipment .....page 202b
Maintenance Materials .....page 204
Mechanical Transmission .....page 204
Metals and Alloys.....page 204
Meters and Instruments, Mechanical .....page 206
Piping, Fittings, Valves and Specialties.....page 206
Pumps .....page 206
Other Equipment .....page 208

BOILERS AND AUXILIARIES

1 **STEAM GENERATORS** — Titusville Iron Works Co, Titusville, Pa. 10-page bulletin No. B-3250A describes construction of Titusville Ticotherm steam generators. Photos, diagrams and tables are included.

2 **CONDENSATE RETURN UNITS** — Roy E Roth Co, Rock Island, Ill. 4-page bulletin No. 199 discusses Type UA packaged condensate return units featuring the Roth turbine type pump. This bulletin contains general catalog data, specifications and prices of the unit.

3 **COAL CRUSHER, SIZER AND SCAVENGER** — Pennsylvania Crusher Co, Liberty Trust Bldg, Philadelphia 7, Pa. 16-page bulletin No. 3007 presents the Pennsylvania Steelbuilt Bradford breaker at the mine, byproduct coke plant and the power station.

4 **BOILER RETURN UNITS**—Roy E Roth Co, Rock Island, Ill., Bulletin No. 200 gives general catalog data, specifications and prices of Type XA packaged boiler return units employing the Roth turbine pump.

5 **DUST CONTROL**—W W Sly Mfg Co, 4700 Train Ave, Cleveland 2, Ohio. 24-page bulletin No. 98 contains information on basic principles that apply to control of dust in industrial plants.

ELECTRICAL EQUIPMENT

6 **UNIT SUBSTATIONS**—Allis-Chalmers Mfg Co, Milwaukee 1, Wis. 20-page guidebook No. 11B6895 simplifies layout of Allis-Chalmers load-center unit substations. Dimensional and arrangement information enables users to determine floor space and head room requirements as soon as the unit is specified.

7 **SYNCHRONOUS MOTORS** — General Electric Co, Schenectady, N. Y. 4-page booklet No. GEA-5113 describes "900 series" high-speed synchronous motors. 4-page booklet No. GEA-5063 discusses synchronous motors for the lumber, pulp and paper industries.

8 **POWER FACTOR**—Electric Machinery Mfg Co, Minneapolis 13, Minn. 20-page booklet No. 200-TEC-1077 explains essentials of power factor in industrial plants and gives a digest of power-factor calculation, why low power factor should be corrected and how it can be done.

9 **SUBSTATION TRANSFORMERS** — Allis-Chalmers Mfg Co, Milwaukee 1, Wis. 8-page bulletin No. 61B6014A covers construction details and performance features of Allis-Chalmers substation transformers for industrial and rural service in ratings from 50 to 500 kva.

10 **ELECTRICAL TAPES** — Minnesota Mining & Mfg Co, 900 Fauquier Ave, St. Paul 6, Minn. 24-page catalog describes 39 Scotch brand electrical tapes.

11 **HIGH - SPEED SYNCHRONOUS GENERATORS** — Apparatus Dept, General Electric Co, Schenectady, N. Y. 4-page bulletin No. GEA-5125 covers construction of Tri-Clad Series 900 high-speed synchronous generators.

12 **DRY-TYPE TRANSFORMERS**—Allis-Chalmers Mfg Co, Milwaukee 1, Wis. 16-page booklet No. 61X7088 discusses installation, care and operation of dry-type transformers.

13 **ELECTRIC PLANTS**—D W Onan & Sons Inc, Minneapolis 5, Minn. 20-page catalog No. A-138A contains a model guide to assist in right selection of electric plants.

14 **SELENIUM TANK RECTIFIERS**—Rectifier Div, Clark Electronic Laboratories, Box 165, Palm Springs, Calif. Bulletin No. 116 presents Celab selenium tank rectifiers in oil-cooled and water-cooled models.

15 **SPLIT-BOLT CONNECTOR** — Burndy Engrg Co, 107 Bruckner Blvd, New York 54, N. Y. 4-page bulletin No. 48Q3, entitled "Servit Selector," simplifies choice of the correct type of split-bolt connector for various conductor combinations.

16 **INSULATED BUILDING WIRES AND CABLES**—U. S. Rubber Co, Rockefeller Center, New York 20, N. Y. 20-page catalog describes line of latex insulated building wires and cable.

17 **RECTIFIERS** — I-T-E Circuit Breaker Co, 19th and Hamilton St, Philadelphia 30, Pa. 12-page bulletin No. 4809 contains a detailed explanation of the principles of the mechanical rectifier.

MAINTENANCE AND SAFETY EQUIPMENT

18 **TUBE EXPANDERS**—Airetool Mfg Co, 342 S Center St, Springfield, Ohio. 4-page bulletin No. 43 describes Airetool tube expanders for expanding and rolling boiler and heat exchanger tubes.

19 **NUT SETTER**—Speed-O-Matic Sales, Inc, 4639 W Washington Blvd, Chicago 44, Ill. 4-page booklet presents construction features and specifications of Speed-O-Matic electric impact nut setter.

20 **MAINTENANCE - EQUIPMENT LINE**—Martindale Electric Co, Box 617, Edgewater Branch, Cleveland 7, Ohio. 60-page catalog No. 27 discusses Martindale line of maintenance, safety and production equipment, including undercutters, bevelers, reamers, hammers, etc.

21 **LUBRICATOR VALVE** — Titeflex, Inc, 595 Frelinghuysen Ave, Newark 5, N. J. 8-page booklet describes Grannan lubricator valve for single-line centralized lubrication systems.

22 **METALLIZING EQUIPMENT** — Metallizing Engrg Co, 38-14 30th St, Long Island City 1, N. Y. 8-page catalog No. 401 describes metallizing guns, air and gas controls, spray booths and dust collectors, blast machines and nozzles, gas flow meter units, and air compressors to give clean, dry air.

(*Continued on page 204*)

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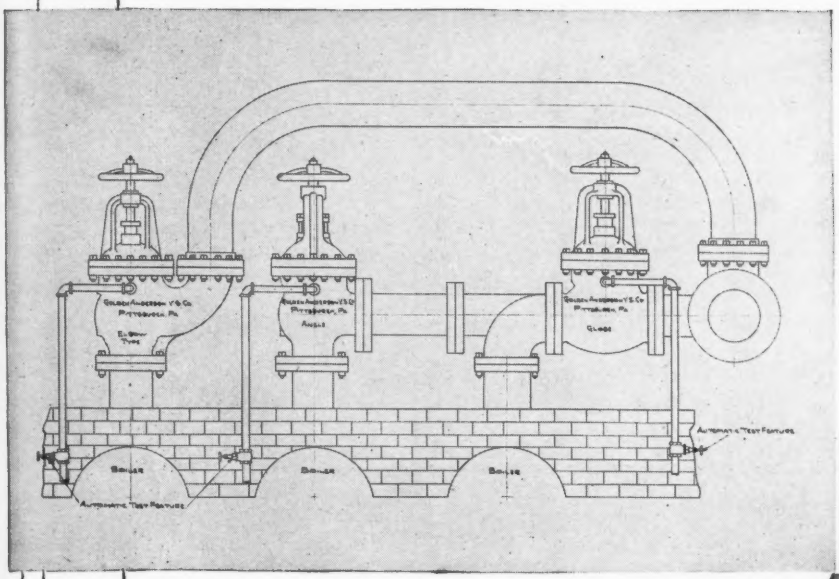
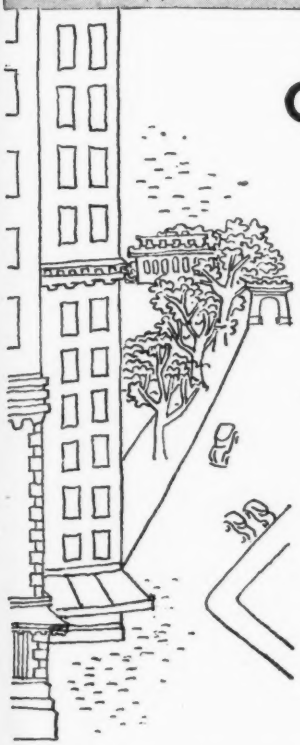


Golden-Anderson single acting Non-Return Valves are standardized in sizes 2½" to 12" in Angle, Globe and Elbow patterns, and are also available in larger sizes, as well as the Cross pattern. Models include 600, 900 and 1500-pound series. The "Double Corliss" dashpot assembly prevents banging, chatter or spinning under any flow conditions.



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non-return

Valves

and these valves, too...

- **Triple Acting Non-Return Valves**
- **Altitude Control Valves**
- **Throttle and Automatic Engine Stop Valves**
- **Positive Control Check Valves**
- **Boiler Check and Stop Valves**
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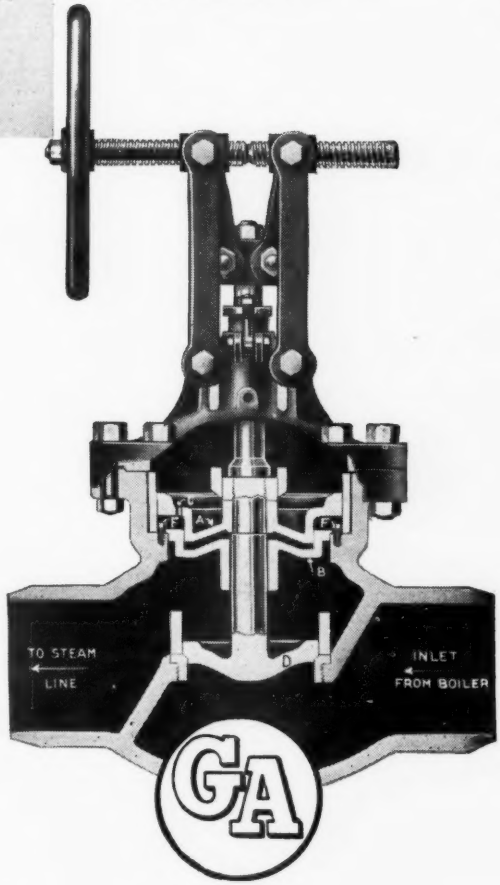
Over 1500 types and sizes of Engineered Protection Valves for dependable, safe flow control.



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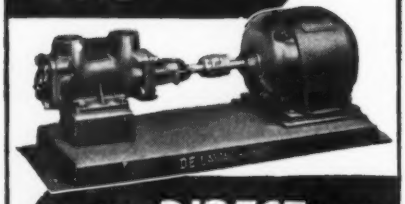
IMO PUMPS



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For further information send for catalog **I-138P.**

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23 SPRAY BOOTHS — Schmieg Industries, Inc, 392 Piquette Ave, Detroit 2, Mich. 28-page catalog No. 481 offers comprehensive information on spray booths, dust and fume control units, mechanical washers, industrial ovens, and sheet metal equipment and accessories.

MAINTENANCE MATERIALS

24 PROTECTIVE COATINGS — Tar Products Div, Koppers Co, Pittsburgh 19, Pa. 12-page folder gives expert direction on application of cold-applied protective coatings, especially designed to prevent corrosion and deterioration.

25 CABLE PROTECTOR — Dearborn Chemical Co, 310 S Michigan Ave, Chicago, Ill. Bulletin features No-Ox-Id Wrap, a recent development for lead-sheathed cable protection in manholes.

26 FLOOR RESURFACER — Flexrock Co, Filbert and Cuthbert, West of 36th, Philadelphia 4, Pa. 4-page folder presents Ruggedwear, a floor resurfacer. A list of users is included.

27 CLEANING CRYSTALS — Skybryte Co, Cleveland 14, Ohio. Folder discusses Skybryte cleaning crystals for cleaning street lighting globes, glass, reflectors, porcelain skylights and factory windows.

MECHANICAL TRANSMISSION

28 MAGNETIC PULLEYS—Dings Magnetic Separator Co, 4740 W McGeogh Ave, Milwaukee 14, Wis. Two 8-page catalogs, No. C-1001A and C-1007A, describe features and applications of electromagnetic pulleys and Alnico magnetic Perma-Pulleys for automatic separation of ferrous and nonferrous materials.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ **RETAINING RINGS** — Truarc Div, Waldes Kohinoor, Inc, Long Island City 1, N. Y. 28-page catalog consists of charts for all standard types of Truarc rings. Data includes ring dimensions, housing and shaft dimensions, groove dimensions, thrust load capacities, materials, tensile strengths and finishes.

29 GEAR TESTER—George Scherr Co, 200 Lafayette St, New York 12, N. Y. 10-page folder presents various models of Parkson gear tester in sizes ranging from 4½ to 36 in. capacity.

30 FLEXIBLE COUPLINGS—Dept C-1, American Flexible Coupling Co, Erie, Pa. 24-page booklet, entitled "Relief from Bearing Wear Grief," describes functions of flexible couplings. A thorough explanation and analysis is given to principles by which couplings operate and their importance in relationship to the equipment they connect.

31 MOTOREDUCERS—Falk Corp, 3001 West Canal St, Milwaukee 8, Wis. 4-page bulletin No. 3101 gives advantages of the new Falk all-steel motoreducer.

METALS AND ALLOYS

32 CORROSION CONTROL — International Nickel Co, 67 Wall St, New York 5, N. Y. 20-page booklet, entitled "Salt as a Corrosion Problem," describes part played by corrosion control in production of salt and use of brine solutions by chemical and food processors.

33 ALUMINUM CASTING ALLOYS — Aluminum Assn, 420 Lexington Ave, New York 17, N. Y. 16-page booklet, entitled "Materials and Methods Manual 35," discusses various types of sand, permanent-mold and die casting alloys available.

34 NICKEL ALLOY STEEL CASTINGS —International Nickel Co, 67 Wall St, New York 5, N. Y. 32-page booklet covers the use of nickel alloy steel castings in railroad equipment, oil production, excavating and dredging, construction projects, steel rolling and forging, oil refining and chemical equipment, power plants, mining, milling and smelting, and miscellaneous applications.

STELLITE—

that "WONDER METAL"— is now a part of

ATLAS Type "B" Steam Reducing Valves

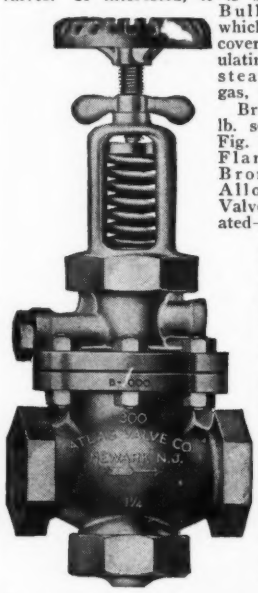
The Pilot Valve is made entirely of STELLITE. The Seat is STELLITE faced.

ATLAS Type "B" is recommended for reducing the pressure of steam where the service demands a tight seating valve and a uniform reduced pressure.

The controlled pressure port is regularly supplied integral with the valve body, but can be furnished for external pilot control connection. The main valve disc and pilot are easily taken out for cleaning or regrinding. The main valve disc will fall out when the bottom bonnet is removed. By taking off the diaphragm cap and unscrewing the pilot valve seat, the entire pilot valve can be lifted out.

When ordering reducing valves, always give the initial and reduced working pressure.

Several pages of this journal would be required to tell all about ATLAS Type "B" valves. If interested, it is best to ask for Bulletin No. 1-A which, in 52 pages, covers ATLAS Regulating Valves — for steam, water, air, gas, or oil.



Briefly, for 250-lb. service we offer Fig. 114—Iron Body Flanged Ends—Bronze or Nickel Alloy Seats and Valves—Pilot Operated—2½", 3", 4", 5", 6", 8". For 300-lb. service we offer the valve shown here — All Bronze — Screwed or Flanged Ends — Bronze or Nickel Alloy Seats and Valves — Pilot Operated, ½", ¾", 1", 1¼", 1½", 2". For 400 and 600-lb. service and for other ATLAS Type "B" Valves, Bulletin 1-A gives all the details. Ask for a copy. To save time use the coupon below. Note, also, the other ATLAS products listed in the coupon.

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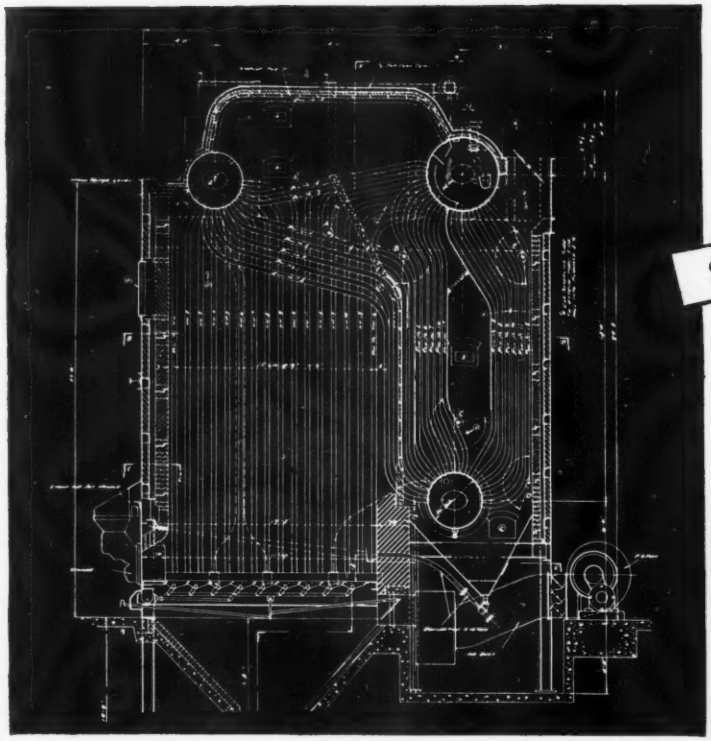
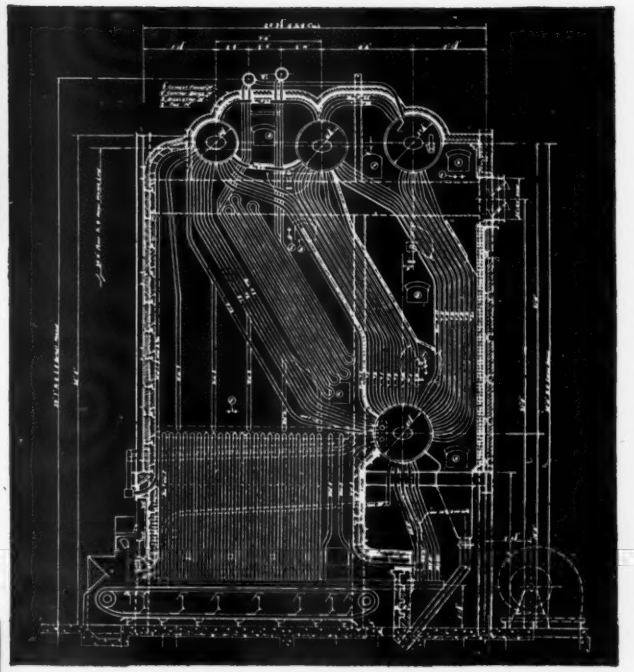


Carry high overloads with high efficiency

SPECIFY Vogt

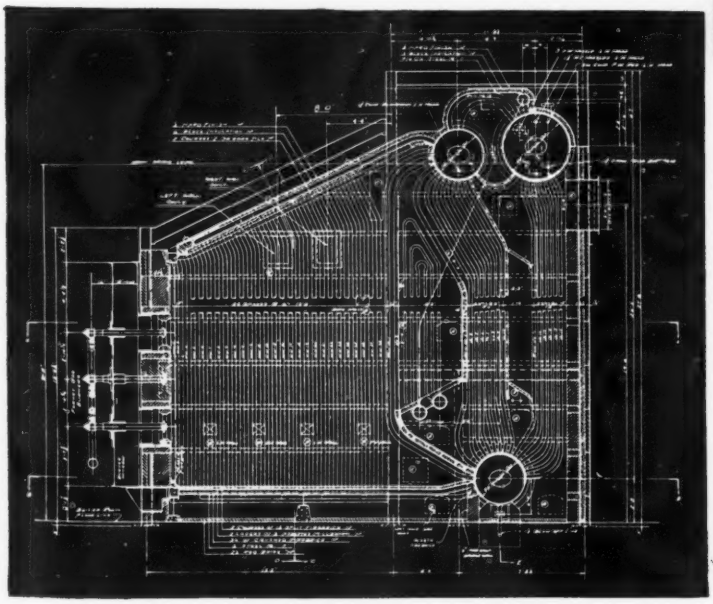
STEAM GENERATING UNITS



CLASS VL — Two 27,500 pounds per hour units, installed at Brown-Forman Distillers Corporation, Louisville, Ky. Features large furnace volume in limited space, with high ratio of radiant heating surface.

CLASS LE — Mt. Carmel Public Utility, Mt. Carmel, Illinois, is served by this 60,000 pounds per hour unit. Generous steam liberating surfaces and steam space permit wide fluctuations in load.

CLASS VR — 70,000 pounds per hour steam generator at Humble Oil and Refining Company, Johnsue, Texas. An efficient, high-duty unit with water cooled furnace, using refinery gas fuel.



Vogt builds a complete line of bent tube steam generators, designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Superheaters, air preheaters, economizers, water walls, and soot blowers can be readily incorporated. Bulletins with general information and showing typical installations are available upon request.

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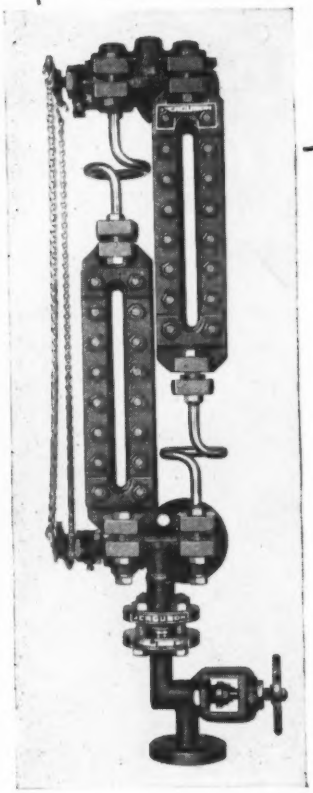

JERGUSON High Pressure Steam Gages are ruggedly built, and have the compact design that means more efficient steam power plant service.

The Jerguson Model 618 HP Gage illustrated, for example, is designed for 600 pounds W.S.P. and has 18" of easy-to-read visibility. It is compactly built and requires less space, yet it has unusual strength. Both chamber and cover are rugged forged steel. A coil at the end takes care of expansion and contraction encountered in high temperature work. Valves are modern flange design, with outside screw and yoke.

For gages that do a better job in the power plant . . . while requiring a minimum of space . . . use Jerguson High Pressure Steam Gages. Available for all pressure requirements.

Jerguson offers a complete line, including inclined gages and distance reading gages, for power plant use.

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METERS AND INSTRUMENTS, MECHANICAL

35 GAS ANALYZER—Burrell Technical Supply Co, 1942 Fifth Ave, Pittsburgh 19, Pa. 8-page bulletin No. 213 discusses applications of Burrell Industro gas analyzers.

36 TIN CONTENT INDICATOR — Wheelco Instruments Co, 847 W Harrison St, Chicago 7, Ill. Bulletin No. D700-1 contains specifications, operation and price information on Wheelco Model 2870 tin content indicator. Educational bulletin No. 8 provides a technical explanation of method of determining tin content of a solder batch.

37 TORQUEMETERS — Testing Equipment Dept, Baldwin Locomotive Works, Philadelphia 42, Pa. 4-page bulletin No. 275 tells how to specify torquemeter requirements and shows how the torquemeter works.

38 CO_2 INDICATOR—Burrell Technical Supply Co, 1942 Fifth Ave, Pittsburgh 19, Pa. 4-page bulletin No. 206 describes construction and operation of the Burrell CO_2 indicator.

39 MEASURING AND CONTROLLING INSTRUMENTS—Brown Instrument Co, Wayne and Roberts Ave, Philadephia 44, Pa. 43-page catalog No. 7301, entitled "Instrumentation for Treatment of Sewage and Industrial Wastes," presents applications and instruments.

PIPING, FITTINGS, VALVES AND SPECIALTIES

40 INTERCHANGEABLE VALVES — Lunkenheimer Co, Cincinnati 14, Ohio. 12-page folder No. 577 introduces the Lunkenheimer Renewo valve threesome.

41 FLEXIBLE METAL TUBING — Pennsylvania Flexible Metallic Tubing Co, 72nd St and Powers Lane, Philadelphia 42, Pa. 12-page bulletin No. 52-9 describes Penflex flexible metallic interlocked galvanized steel hose and bronze steam hose. 6-page folder discusses application of flexible tubing for air, steam, gases and volatiles.

42 WELDING BRANCH PIPE OUTLET—Bonney Forge & Tool Works, Allentown, Pa. 24-page catalog, entitled "Bonney WeldOlets for Branch Pipe Outlets," presents complete information on how WeldOlet fittings reduce piping costs.

43 WELDING HOSE — Hewitt Rubber Div, Hewitt-Robins Inc, Buffalo 5, N. Y. Pamphlet explains ease of handling, the greater safety and faster operation achieved with Twin-Weld hose.

PUMPS

44 CENTRIFUGAL PUMPS — Duriron Co, Dayton 1, Ohio. 20-page bulletin No. 815 on Model 40 Series M centrifugal Durcopumps includes their newest design features and complete exploded views of all parts.

45 PUMP LINE—Economy Pumps, Inc, Hamilton, Ohio. 4-page catalog No. B346 discusses construction details of vertically split case high-pressure pumps. 8-page catalog No. F-447 covers applications of horizontal non-clog sewage pumps.

46 OIL-OPERATED PUMPS—American Engrg Co, Philadelphia 25, Pa. 20-page catalog "J" presents Hele-Shaw variable-discharge, oil-operated pumps and controls, both high and low pressure.

47 INDUSTRIAL PUMPS—Roy E Roth Co, Rock Island, Ill. 18-page bulletin No. 101 describes Roth heavy-duty flexible-coupled pumps, special metal pumps and a series of industrial pumps. 4-page bulletin No. 103 discusses the new Monobilt pump, where pump and motor are combined into one compact unit.

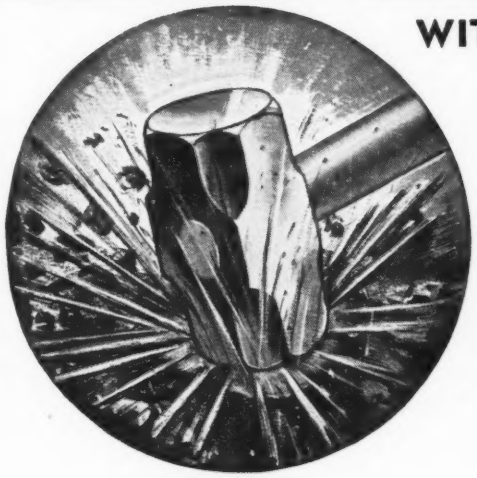
48 TURBINE PUMP — Peerless Pump Div, Food Machinery and Chemical Corp, 301 West Ave 26, Los Angeles 31, Calif. 8-page bulletin No. B-200 covers Champion Peerless deep well turbine pump.

49 CHEMICAL PUMP—Milton Roy Co, 1300 E Mermaid Rd, Philadelphia 18, Pa. 4-page bulletin No. 488 describes the Airometric, a controlled-volume chemical pump with rotary air or gas motor drive.

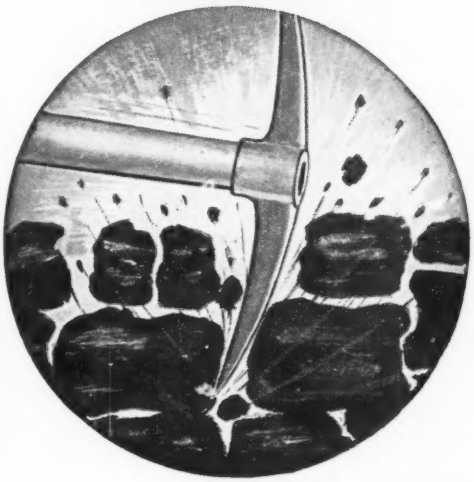
Better Coal Preparation for Greater Combustion Efficiency

WITH

AMERICAN SHREDDER RING CRUSHERS



= RAGGED FIRE BED → EXCESSIVE CO_2 → ASH PIT LOSS

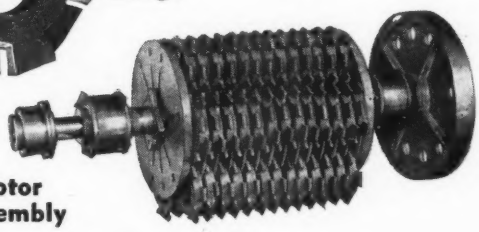


= EVEN FIRE BED → UNIFORM COMBUSTION

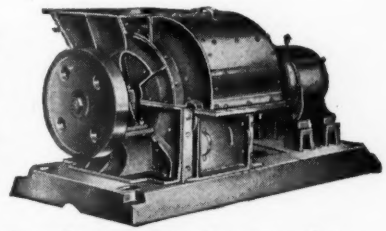
Every pound of coal means *more* BTU's—more efficient heat, when Americans do the preparation job! ROM coal is reduced rapidly with exacting control of fines, uniform sizing and no oversize—at a cost of less than 1¢ a ton. The result: Americans pave the way for a loose, uniform firebed quickly responsive to sudden steam demands—without excessive ashpit drop or unnecessary CO_2.

Shredder Ring

Patented manganese steel shredder rings, exclusive with American Rolling Ring Crushers, *split the coal* by impact rather than by crushing. Shown below is the rotor assembly, with its many rows of shredder rings. Each ring has twenty cutting edges—and revolves on individual shaft, free to deflect from tramp iron without damage.



Rotor Assembly



American Type "S" Rolling Ring Crusher, with heavy cast steel housing and sectional construction, secured at dust-tight machined joints with coupling bolts for easy access to crushing chamber.

Write for details on efficiency of coal preparation in power plants with American Crushers.

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

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3. **To reduce the possibility of carry-over.**
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6. **To secure reduced-solids water at a cost comparable to softening.**

ILLCO-WAY DE-ALKALIZING EQUIPMENT assures accurate control of boiler feed waters. It removes all excessive bicarbonates and converts the remaining sulphate and chloride solids to non-scale forming salts.

On the very common high bicarbonate water, ILLCO-WAY De-Alkalizing equipment produces a feed water low in dissolved solids and free of all scale-forming properties. Controls are provided to maintain desired alkalinity.

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ENGINEERING AND EQUIPMENT DE-IONIZERS for process water treatment and treatment of liquids and solutions other than water; waste treatments; reclamation of specific constituents. DE-ALKALIZERS: Boiler feed (external); bottling water. SOFTENERS: Industrial, domestic. FILTERS, etc.

OTHER EQUIPMENT

50 RADIANT HEATING—A M Byers Co, Pittsburgh, Pa. 8-page bulletin gives condensed answers to the 50 questions most frequently asked about radiant heating.

51 GAS UNIT HEATERS — Automatic Gas Equipment Co, 301 Brushton Ave, Pittsburgh 21, Pa. 4-page folder presents Series C gas unit heaters for heating, ventilating and drying commercial industrial buildings.

52 COMPRESSION, DEHYDRATION PLANT—Clark Bros Co, Olean, N. Y. 4-page folder discusses interesting features about the Barnsdall Oil Company's Placedo compression and dehydration plant.

53 MAGNETIC STARTERS — Ward Leonard Electric Co, 31 South St, Mt. Vernon, N. Y. 8-page bulletin No. 4110 describes new line of ac magnetic starters of the across-the-line, non-reversing type. 4-page bulletin No. 4130 presents new line of ac combination magnetic starters with circuit breakers.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ **CONTROLS**—Wheelco Instruments Co, 847 W Harrison St, Chicago 7, Ill. 4-page bulletin No. Z6500 contains company's line of indicators, controllers, recorders and combustion safeguards.

54 WIRE ROPE—Preformed Wire Rope Information Bureau, 520 N Michigan Ave, Chicago 11, Ill. 16-page booklet, entitled "The Wonders of Wire Rope," tells the uses of wire rope, how it is made, and other interesting data.

55 WIRE ROPE—Macwhyte Co, 2940 4th Ave, Kenosha, Wis. 4-page folder answers 20 questions about preformed wire rope. Photographs are included.

56 CONTROL SYSTEM — Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa. 24-page catalog No. ND4B describes the L&N pneumatic control, which is a complete, air-actuated control system.

57 EARTHMOVERS—R G LeTourneau, Inc, Peoria, Ill. Broadside TP-163 lists specifications for the B Tournapull—giant earthmover. Broadside TD-119 lists features of size, power and speed available in the B Tournadozer, basic specifications and advantages to be gained by matching this big production tool with the B Tournapull.

58 POTENTIOMETERS—Brown Instrument Co, Wayne and Roberts Ave, Philadelphia 44, Pa. 32-page catalog No. 15-13 presents Electronik strip-chart electric-control potentiometers, strip-chart and circular-chart recorders, precision indicators, strip-chart and circular-chart recorders, precision indicators, strip-chart and circular-chart controllers, indicating controllers, pyrometric switches, thermocouple and radiamatic assemblies.

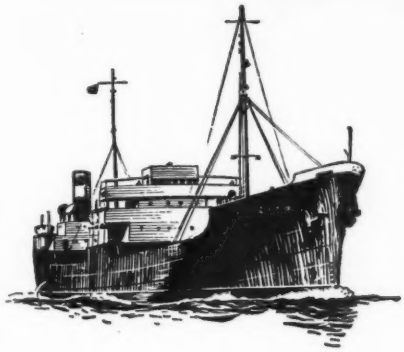
59 STEAM-TURBINE BLADE DEPOSITS — Allis-Chalmers Mfg Co, Milwaukee 1, Wis. 16-page booklet No. 28B7030 tells how to identify and prevent steam-turbine blade deposits.

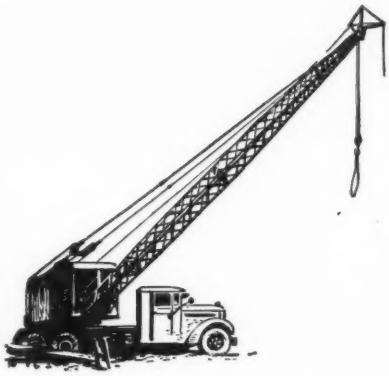
60 WATER DEMINERALIZERS — Ion Exchange Products Dept, American Cyanamid Co, 30 Rockefeller Pl, New York 20, N. Y. 26-page booklet, entitled "Filt-R-Stil Demineralizers Deliver Low-Cost Chemical Equivalent of Distilled Water," cites advantages of demineralized water over distilled water, describes briefly chemical and mechanical principals of demineralization by ion exchange and gives data on calculating costs for demineralizing various raw waters.

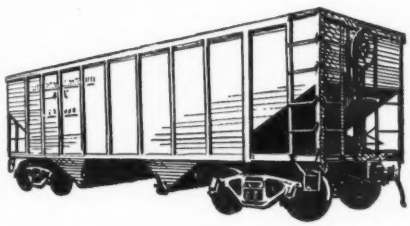
61 HARDFACING ALLOYS—Dept 1968, Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y. 16-page booklet describes complete new line of Airco hardfacing alloys.

62 BRAZING FITTINGS — Handy & Harman, 82 Fulton St, New York 7, N. Y. Bulletin No. 17 gives instructions for brazing fittings to piping and tubing with Easy-Flo and Sil-Fos.

Strengthen Fabricated Structures Reduce Bulk and Deadweight Decrease Maintenance Expenses







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HIGH STRENGTH LOW ALLOY STEELS *containing* NICKEL

Stretch your dollars with high strength low alloy steels containing nickel...

Thin, light sections of these economical steels provide the same strength as thicker, heavier sections of plain carbon steel.

Moreover, these nickel alloyed steels resist abrasion and erosion as well as many types of corrosion, and thus lengthen equipment life substantially. In addition, they may be fabricated as easily as carbon steel, and often decrease unit-labor costs.

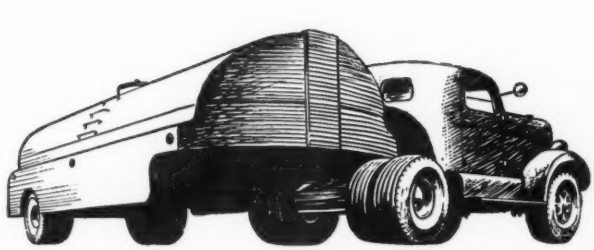
Produced under various trade names by leading steel companies, these high strength steels containing nickel along with other alloying elements, provide three basic advantages:

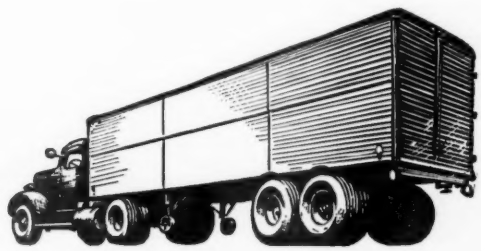
1. **High strength in the as-rolled condition, permitting important weight reductions.**

2. **Excellent performance response to usual fabrication operations assuring easy forming and welding.**

3. **Good resistance to corrosion, abrasion and impact.**

Specify high strength nickel alloy steels where weight saving and durability are required. Consultation on their use in your products or equipment is invited. Write today.





EMBLEM OF INCO SERVICE

Over the years, International Nickel has accumulated a fund of useful information on the properties, treatment, fabrication and performance of engineering alloy steels, stainless steels, cast irons, brasses, bronzes, nickel silver, cupro-nickel and other alloys containing nickel. This information is yours for the asking. Write for "List A" of available publications.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

SEAL
THAT STEAM!

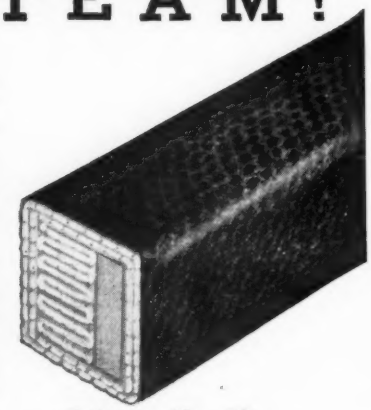
Advertisement

PACKINGS HOLD IMPORTANT PLACE IN MODERN PLANT

PHILADELPHIA, PA.—To keep pressure up and cost down, modern plants, "leak-proof" moving and stationary parts with Belmont Packings.

Since 1893, Belmont Packings have been solving these problems for industry, with highly specialized packing designs and constructions to meet every industrial requirement. Here, we illustrate just two Belmont steam service leaders. Our catalog displays all.

Belmont No. 30, for high pressure steam rods and expansion joints. Made of closely woven asbestos cloth treated with special rubber compound. Center block pleated on itself (accordian fashion) at approx. 90° angle with rod, affording high resiliency and flexibility. Provides extra take-up and "edgewear" if packing wears toward the rod.



Belmont No. 30
High Pressure Asbestos Packing for rods, expansion joints, air and gas.

BELMONT PACKINGS

Belmont No. 754, for reciprocating rods and plungers against high pressure steam, expansion joints, etc. Made of long fibre asbestos yarn with fine copper wire twisted with each strand. Lubricated throughout and graphited, this square braided packing retains its softness over a long period of use.

Belmont Packings are easy to obtain and convenient to see; distributors are located in every large industrial center, with sample kits displaying Belmont constructions and materials.

Identification is simple. Belmont Packings wherever practicable, are packed in attractive and secure boxes, bearing our orange-colored trade-mark on a blue background.

The Belmont Catalog is available. This invaluable reference book reduces packing facts down to simplest forms. Write on your company letterhead for free copy

Investigate how Belmont can serve you! Contact our local distributor, or write us direct.

Belmont No. 754
Square Braided Asbestos Wire Inserted Packing for reciprocating rods and plungers, expansion joints, etc.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

Steam, Water, Oil, Gas, Air, Acids, Alkalies, Ammonia

Rings, Spirals, Coils, Reels, Spools, Sheets, Gaskets.

THE BELMONT PACKING & RUBBER COMPANY
BUTLER AND SEPVIVA STREETS • PHILADELPHIA 37, PA.

APPOINTMENTS

Hagan Corp, Pittsburgh, Pa., elects D J Erikson president of the firm and its subsidiary companies—Calgon, Inc, Hall Laboratories, and Buromin Co. Erikson succeeds J M Hopwood, who becomes chairman of the board of directors of the Hagan group. R R Donaldson is now vice-president in charge of engineering, and M J Boho is appointed vice-president in charge of sales.

E W Butzler has been made business manager of **Hall Laboratories,** Pittsburgh, Pa.

Calgon, Inc, Pittsburgh, Pa., names Owen Rice vice-president in charge of commercial chemical sales.

Marshall N Waterman joins **Westinghouse** lamp div, Bloomfield, N. J., as staff assistant to Ralph R Brady, commercial engineering manager.

Blackmer Pump Co, Grand Rapids, Mich., has established a direct factory branch sales office at 608 S Dearborn St, Chicago, Ill. This office was previously operated by Bart C Young as a manufacturer's representative for Blackmer, and Young continues to direct activities as district sales manager. Assisting him are John H Young and Paul B Duggan as district representatives. All of Iowa, central and southern Indiana and a small area in Kentucky around Louisville will be covered in addition to original territory. Globe Machinery and Supply Co, Des Moines, Iowa, is no longer a Blackmer agent, but continues as jobber in that area under Chicago sales office. Also, under this new organization plan, the Chicago office will maintain a branch office at 310 Test Bldg, Indianapolis, Ind.

William H Maloney was appointed manager of **Blackmer's** Los Angeles branch sales office, which has been moved to 736 E Washington Blvd.

Crocker-Wheeler Electric Mfg Co, Ampere, N. J., reopened its branch office in Ellicott Square Bldg, Buffalo, N. Y., operating directly under the New York district manager. It is headed by Louis E Rau.

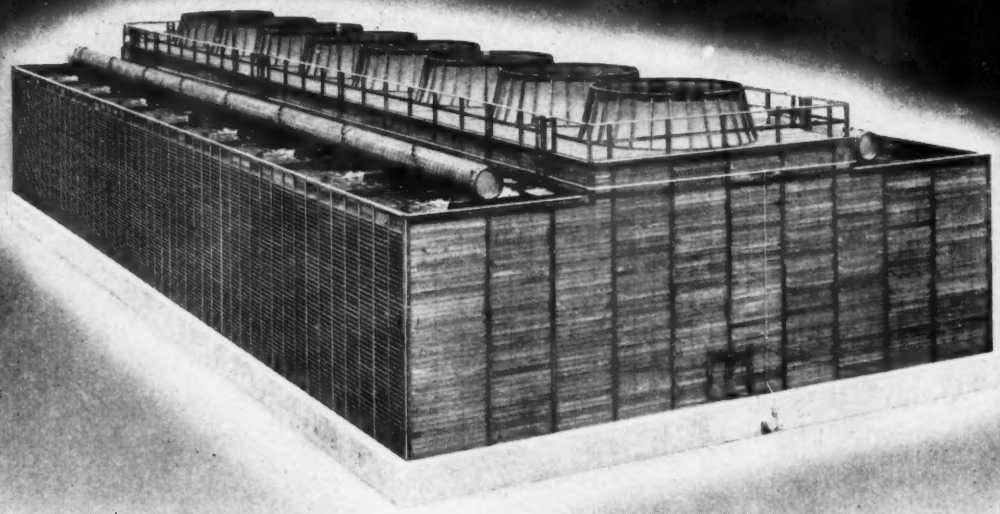
Dawson J Burns of **Ward Leonard Electric Co,** Mount Vernon, N. Y., who resigned the office of president of the company, was elected chairman of the executive committee. Arthur A Berard became president and general manager.

Name of Peerless Pump Div, Food Machinery Corp, is changed to Peerless Pump Div, **Food Machinery and Chemical Corp.**

Greer Hydraulics, Inc, announces opening of a branch office at Keith Bldg, Dayton, Ohio, under direction of Sumner L Barton.

Allis-Chalmers Mfg Co has named Joseph N Banky sales representative in the firm's Chicago district office. B F Bilsland was made manager of the company's newly

Specify MARLEY Double-Flow



WITH THE OPEN DISTRIBUTION SYSTEM

Marley Double-Flow Cooling Towers have an Open Distribution System.

And why is that important?

Because the Marley Open Distribution System is . . .

EASY TO INSPECT . . . it's on top of the tower, in broad daylight, never hidden from view.

EASY TO REGULATE . . . a widely varying GPM may be circulated over the tower without revamping the distribution system.

EASY TO CLEAN . . . cleaning is done with an ordinary broom . . . it is not necessary to shut down the tower or take it apart in any way.

UNUSUALLY SAFE . . . no climbing through small portholes, across slippery members . . . no danger of falling through the filling while crawling about in narrow spaces in semi-darkness while inspecting or cleaning.

VERY ECONOMICAL . . . because it's easy to clean . . . and clean distribution systems insure top performance and low operating costs. Also, the diffusion decking underneath gives excellent water break-up with no added pumping head.

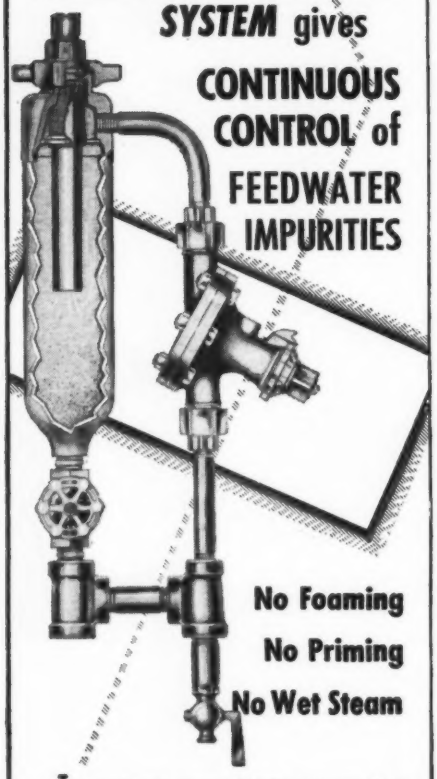
Ask for a MARLEY Factory-Trained APPLICATION ENGINEER to tell you more about the MARLEY DOUBLE-FLOW Cooling Tower with the OPEN DISTRIBUTION SYSTEM. He'll be glad to help you solve YOUR water cooling problems. No cost or obligation.

MARLEY COOLING TOWERS

THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

BOILER BLOW-OFF no longer HIT-or-MISS

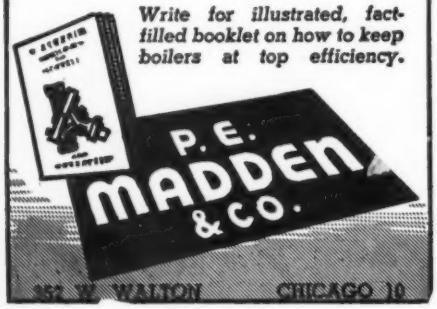
the MULTOMETER SYSTEM gives CONTINUOUS CONTROL of FEEDWATER IMPURITIES



No Foaming
No Priming
No Wet Steam

Intermittent, manual boiler blow-off is inaccurate, time-consuming, and wasteful of water and heat. The MULTOMETER is the modern, effective way to control the impurities that exist in *all* boiler waters. It is instantly adjustable to fit variations in load. It is easily installed on all boilers. It cuts working time and fuel costs. It is available in simple control units or in combination with heat reclaiming equipment. Hundreds in continuous operation for 10 years or more.

Write for illustrated, fact-filled booklet on how to keep boilers at top efficiency.



P. E. MADDEN & CO.

351 W. WALTON CHICAGO 10

formed Midwest region. Territory includes six district and six branch offices in Chicago, Davenport, Rockford, Indianapolis, Evansville, Louisville, Kansas City, Omaha, Milwaukee, Minneapolis, Duluth and St Louis.

P M Pottetti is now sales manager for **Cyclotherm Corp,** New York City. Guy B Smith succeeds Pottetti as assistant sales manager in charge of advertising and sales promotion.

Eutectic Welding Alloys Corp, New York City, appointed Paul E. Miller and Jack R Koske to the board of regional sales supervisors. Miller will be responsible for Eutectic field engineers in the Mideast and Koske in the East Central area.

Ronald B Smith has joined the engineering staff of **M W Kellogg Co,** Jersey City, N. J. Smith's special fields include gas turbines, superchargers, condensers, oxygen plants and power machinery in general.

Monsanto Chemical Co, St Louis, Mo., made the following changes in their administrative organization: Vice-presidents Osborne Bezanson and R R Cole were elevated to the executive committee. W G Krummrich is now acting general manager of organic chemicals div and John Christian acting general manager of phosphate division. Vice-president Francis J Curtis will continue as secretary but is also made sales coordinator. Dr Carroll A Hochwalt, vice-president in charge of the firm's central research dept at Dayton, Ohio assumes responsibility for coordination of research and development activities. Hochwalt is succeeded by Howard K Nason, who will serve as acting director. Kenneth W Short became acting purchasing agent of plastics div upon retirement of Glenn M Bullard. Fred G Gronemeyer is appointed chief engineer of organic chemicals div but will continue as director of general engineering.

Robert M Honegger, general manager of **Farrel-Birmingham Co's** Buffalo plant, was elected a member of the board of directors.

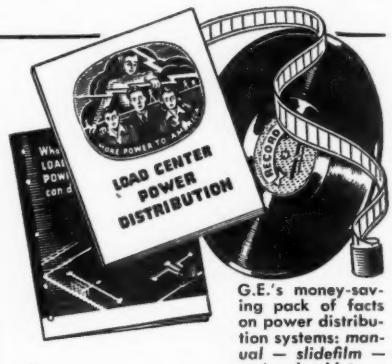
Hammel-Dahl Co, Providence, R. I., has chosen Arduser & Co, Tulsa, Okla., as their dealer representative.

Three additional distributor outlets have been announced by **Ampco Metal, Inc.,** Milwaukee, Wis. They are: Welding Engineering Sales Corp, Buffalo and Syracuse, N. Y.; Southern Oxygen Co, Knoxville, Tenn.; Arizona Welding Equipment Co, Phoenix, Ariz.

All-State Welding Alloys Co, White Plains, N. Y., appointed Herman C Phelps sales manager. Phelps, formerly the firm's West Coast regional sales manager, has moved to White Plains.

A branch office of **Cooper-Bessemer Co,** Mt. Vernon, Ohio, is now located at 122 South Michigan Ave, Chicago, Ill., under direction of Robert S Bowie. Bowie's activities continue under supervision of

One manufacturer saved $10,400 in power equipment—*CAN YOU?*



G.E.'s money-saving pack of facts on power distribution systems: *manual — slidefilm — review booklets.*

Get these eye-opening facts on power distribution systems to your key men—and see how much YOU can save

With "load-center" power distribution, one medium-sized manufacturer saved $10,400 in power equipment costs! Another cut equipment costs by 15 per cent—another by 17 per cent. *And* load-center systems help save money in *five other* ways, too. So get the facts to your key men *now*—open their eyes to this new way to power economy in your plant. It's easy. Here's all you do—

FREE to business management

Examine the General Electric *Load-Center Power Distribution Manual* free of charge. It covers every phase of load-center systems from a discussion of the fundamentals to examples of actual installations in plants like yours. It's prepared by experts, *without sales bias,* and it's designed to help you solve *your* power problems. Look through it. Satisfy yourself that it will pay off for you, then—

Get a *FREE* showing of the slidefilm

Your key men will quickly learn about power distribution systems in this modern, absorbing, *visual* way. Here's a General Electric slidefilm *with sound* that tells *what* load-center distribution is—*what* it can do for you. Prepared in terms that get over fast—stick in the memory. Show it, and—

Get *FREE* review booklets

They highlight the lessons of the film, and they're ideal for individual study and review. You can have as many as you like.

ACT NOW! Don't delay. Remember—load-center distribution means *reduced costs.* So start the ball rolling, by filling in the coupon below, and we'll rush you G.E.'s *Load-Center Power Distribution Manual.* And, with it, we'll tell you how to arrange for a free showing of the slidefilm. *Do it now!*

FREE
TO BUSINESS MANAGEMENT

Attach to your business letterhead

General Electric Co.
Section D684-11
Schenectady 5, N. Y.

Please send me a sample copy of the G-E *Load-Center Power Distribution Manual* without cost or obligation, with details on how I can arrange a FREE SHOWING of the film. (Extra copies at regular manual price—$1.00.)

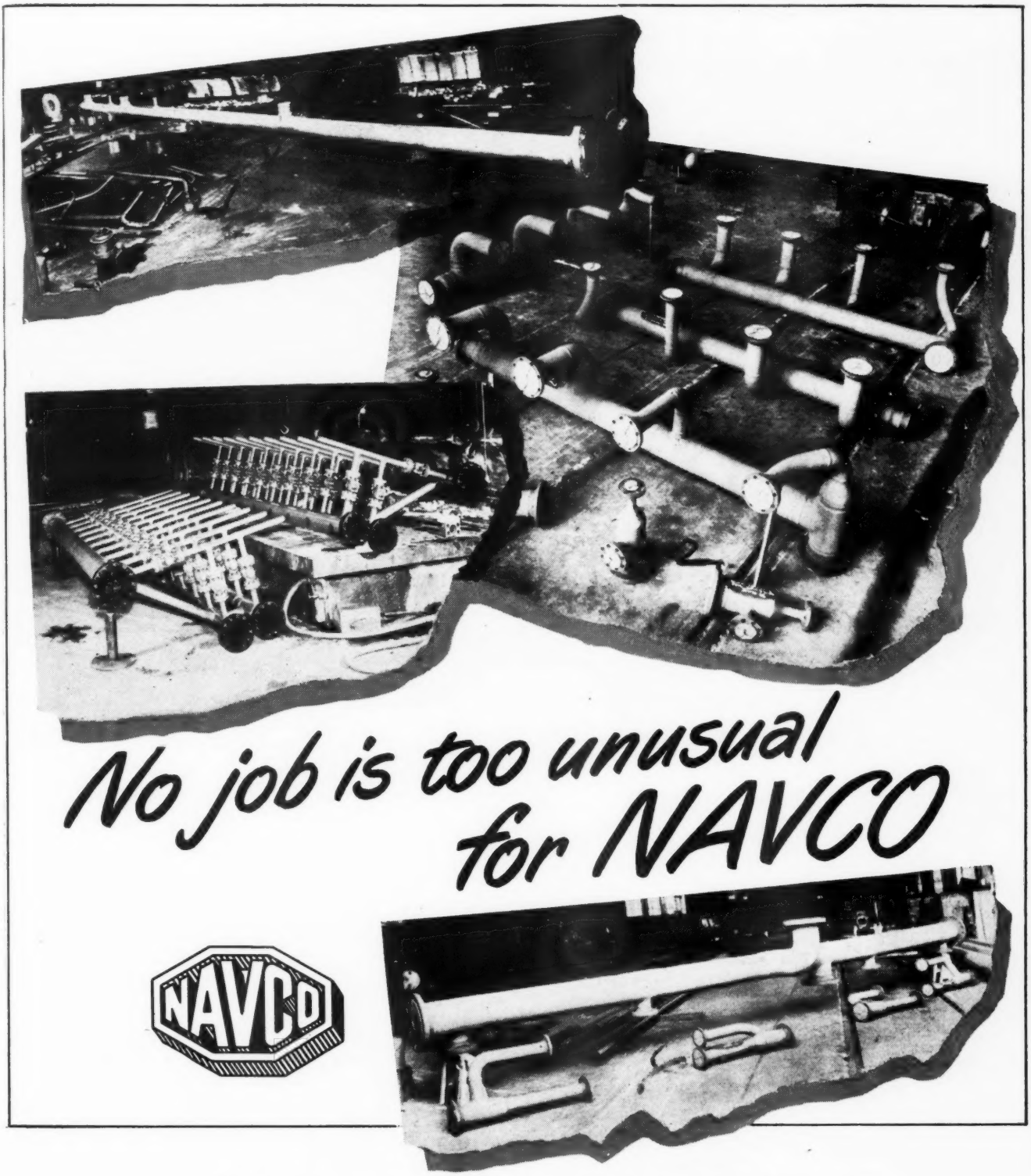
Name_____ Title_____

Company_____

Street_____

City_____

GENERAL ELECTRIC



No job is too unusual for NAVCO

Whether you require a simple pipe bend or a complicated prefabricated assembly, Navco can help you. As shown above, Navco Shops are equipped to handle Chrome Moly, Stainless, Carbon Steel and Copper, in addition to any of the many other Ferrous and Non-Ferrous materials.

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

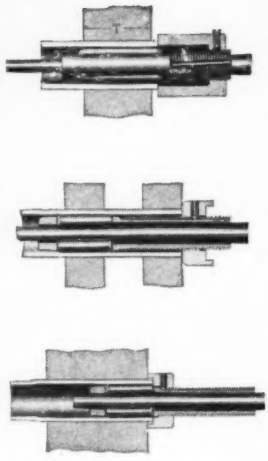
NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI

Wiedeke

TUBE EXPANDERS FOR DEPENDABLE . . . ECONOMICAL SERVICE

No. 254

No. 269



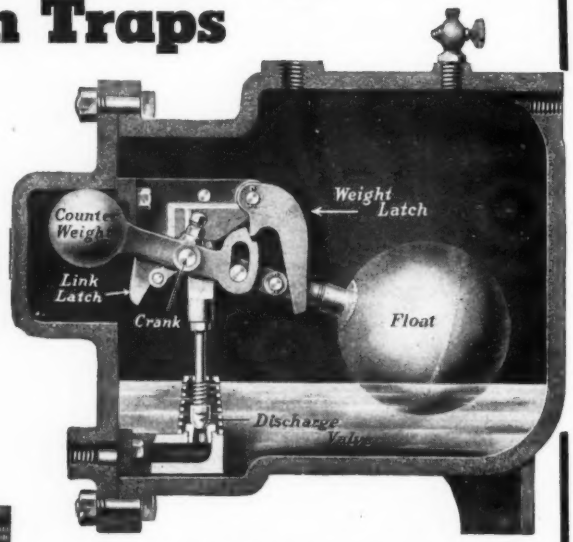
WIEDEKE Adjustable Tube Expanders
Designed especially for rolling small tubes in Condensers, Heat Exchangers and similar units
Style No. 254 is adaptable for rolling tubes to a depth of 2"
Style No. 269 is adaptable for rolling tubes in heavier or multiple tube sheets.
Leading users everywhere know there is a Wiedeke Tube Expander for every application.
For complete details, see your local dealer or write us today

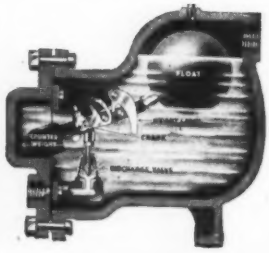
The Gustav Wiedeke Company
DAYTON 1, OHIO

SPEED DRAINAGE with NICHOLSON

Non-Wire Drawing Steam Traps

As indicated at right, the valve of Nicholson weight - operated traps opens wide instantaneously to discharge condensate, after which it closes tight — instantaneously. 3 types for every application; pressures to 1500 lbs. CATALOG 448.





OTHER TROUBLE-PROOF FEATURES — Leak-proofed by positive fluid seal over valve; not dependent on buoyancy or weight of float; unaffected by re-evaporation of condensate; rugged, for unavoidable abuse; unaffected by dirt, pulsation etc.; stainless steel where it counts.

W. H. NICHOLSON & CO. 125 OREGON ST. WILKES-BARRE, PA.

Charles L White, district manager for the company in the north central area. White's headquarters are in the home office.

Trumbull Electric Mfg Co, Plainville, Conn., assigns H S Hill manager of its office in Schenectady, N. Y. Hill will be responsible for all company relations with General Electric Co. A T Allison succeeds Hill as district manager of Trumbull's southeast sales district with offices at 700 West 5th St, Charlotte, N. C.

Tarver S Murphy Jr has joined **Equipoise Controls Inc,** 100 Stevens Ave, Mt. Vernon, N. Y., in capacity of vice-president. Murphy will specialize in sales engineering activities covering Equipoise line of industrial and laboratory instruments and related equipment in Northeastern area.

C E Tweedle of **Askania Regulator Co,** Chicago, has been elected vice-president of the firm.

Cutler-Hammer, Inc, Milwaukee, Wis., selected Communications Electrical Equipment & Supply Co, Manila, as distributor of its electrical apparatus in the Philippines.

Appointment of Berney L Morgan as sales representative in Houston territory was announced by **France Packing Co,** Philadelphia. Morgan will cover the Gulf Coast, central and east Texas, Louisiana and southern Arkansas, with headquarters in Houston, Texas.

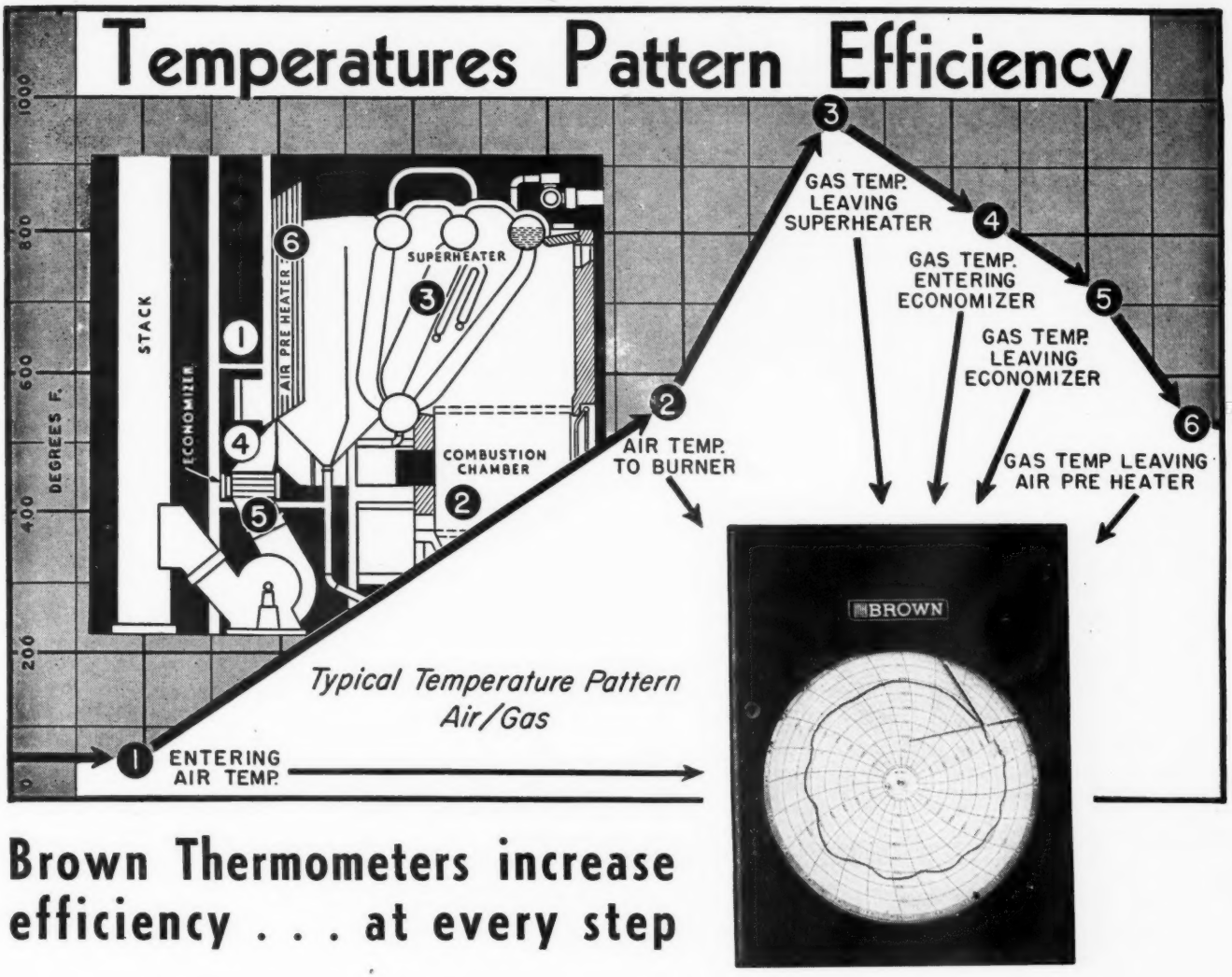
Hungerford & Terry, Inc, Clayton, N. J., chose William M Longshore, 4109 Polk St, Houston, as representative for their Texas territory.

General Electric Co has made several personnel changes in its divisions as follows: Harold F Smiddy, in addition to continuing as general manager of the chemical dept, succeeds George R Prout as general manager of air-conditioning dept. Prout, now assistant general manager of nucleonics dept, will become general manager on Jan 1, replacing Roy C Muir, who will continue as consultant. Smiddy will have headquarters at both Bloomfield, N. J. and Pittsfield, Mass. Prout will be stationed at Hanford atomic energy works, which the company operates for the Atomic Energy Commission near Richland, Wash. Robert S. Neblett, assistant general manager who has been at Hanford, will make his headquarters at Schenectady, where he will be in charge of nucleonics dept activities in that region.

C I MacGuffie and R C Freeman have been appointed manager of sales and manager of engineering, respectively, of **GE**'s welding divisions. A F Vinson is the new manager.

GE has also announced these appointments: In switchgear divisions Vernon L Cox is named manager of engineering. C H Black becomes manager of engineering of construction materials divisions. Conduit products division now has W Rex Becker as sales manager. Roger F Hinckley is now product promotion manager of wiring device div. John W Butler has been named manager of commercial engineering divi-

Temperatures Pattern Efficiency



Brown Thermometers increase efficiency . . . at every step

The above pattern shows air/gas temperatures for a typical boiler. Maintaining this temperature pattern at each step from the air intake to the stack is important for high boiler efficiency.

By having a continuous record of these important temperatures, your power engineer can maintain high efficiency. Without them, he is operating in the dark . . . inefficiencies show themselves only in unexplainably high power costs.

Brown Recording Thermometers for these points are an economical investment for large or small power plants. The advanced design of these instruments provides a degree of accuracy and utility never before offered in a thermometer. The special heat treating and stress relieving of the spiral actuating elements alone is an achievement in manufacturing that means better performance to you. Brown Thermometers last for years and years . . . but pay for themselves quickly in lower power costs.

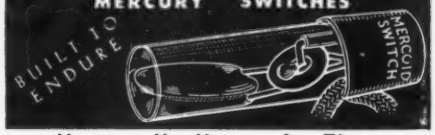
Your local Brown Engineer will be glad to discuss these steps to increased power plant efficiency with you. Write for further information. Send for your copy of Catalog 6708 describing Brown Recording Thermometers.

Write for Catalog 6708

The Brown Instrument Company, 4490 Wayne Avenue, Philadelphia 44, Pa.
DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR CO.
Offices in principal cities of the United States, Canada and throughout the world.

BROWN *Advanced Instrumentation* **FOR BETTER PROCESSING**
Product of MINNEAPOLIS **Honeywell**

MERCOID
MERCURY SWITCHES



Universally Known for Their Superior Quality and Workmanship

They are not affected by dust, dirt or corrosion and have many definite applications where open contacts are not suitable. Various types available. MERCOID is your guarantee of the best in mercury switches. Further information sent upon request.

LET MERCOID SOLVE YOUR CONTROL PROBLEMS

MERCOID CONTROLS WITH MERCURY CONTACT SWITCH rank first for convenience of adjustment—dependable service and long life.

They are designed for various applications requiring the control of pressure, temperature, liquid level and mechanical operation.

AVAILABLE IN EXPLOSION-PROOF CASE FOR HAZARDOUS LOCATIONS

Complete Mercoid Catalog sent upon request.

THE MERCOID CORPORATION, 4201 BELMONT AVE., CHICAGO 41, ILL.

EISLER TRANSFORMERS

STANDARD & SPECIAL
From ¼ to 400 KVA
up to 15,000 volts
We manufacture a complete line of:
*AIR, OIL OR WATER-COOLED DISTRIBUTION TRANSFORMERS

**Special Designs available to meet Customers' Specific Requirements*

TRANSFORMERS FOR
*ELECTRIC FURNACES
*WELDING
*HEATING
*PHASE CHANGING
Etc.

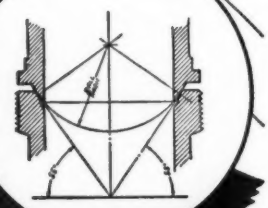
POWER & LIGHT TRANSFORMERS
For isolation of Light from Power, or Light from Telephone

EISLER TRANSFORMERS *are manufactured strictly to Standards of the N.E.M.A., A.S.A., and A.I.E.E.*

WRITE FOR SPECIAL CATALOG

EISLER ENGINEERING CO., INC.
Chas. Eisler, Pres.
757 South 13th Street, Newark 3, N. J.

CATAWISSA BALL-TO-ANGLE SEAT gives you a PERFECT SEAL...



...even when the pipe is not perfectly aligned!

HOT FORGED from solid, rectangular steel bars, Catawissa Pipe Unions are free from sand and blow holes. The ball-to-angle seat design plus their ability to expand and contract with the pipe give you sure fire dependability . . . a perfect seal for every application!

HOT FORGED STEEL
STAINLESS STEEL
Full ACME Threads or U. S. V-Threads in Union nuts and on female end.
STANDARD AND DOUBLE EXTRA HEAVY

WRITE FOR COMPLETE ENGINEERING DATA AND YOUR COPY OF BULLETIN 10-A

CATAWISSA VALVE & FITTINGS CO.
206 Mill St. • CATAWISSA, PENNSYLVANIA

sions; C E Sutton Jr, assistant manager, power transformer sales division; and C W Lamplough, manager, order service division.

Gilman H Lowery is manager of the new plant built by **Johns-Manville** at Tilton, N. H.

Twin Disc Clutch Co, Racine, Wis., elects John H Batten president. He will also maintain an active interest in company affairs as chairman of board of directors.

Salvadore R Corrado and Mathias S Volk, partner-owners of Philadelphia Electrical & Machinery Co, 1772 N Front St, Philadelphia 22, Pa., are now distributors for **Ideal Electric & Mfg Co,** Mansfield, Ohio. They will work in conjunction with Orney E Dunnum, Ideal's district manager in Philadelphia.

Kieley & Mueller names Al Bailey general manager. Bailey will make his headquarters at the company's plant in North Bergen, N. J., and in addition will spend considerable time with their distributors throughout the United States.

Jean Santschi has elected, under a company retirement plan, to resign his position as manager of installation and service dept of **Nordberg Mfg Co,** Milwaukee, Wis. While Santschi's retirement was effective September 30, 1948, he will continue to spend considerable time with Nordberg in Milwaukee and in the field in a consulting capacity. Matt Stromberg replaces Santschi.

Westinghouse Electric Corp announced formation of an atomic power div with Charles H Weaver as manager.

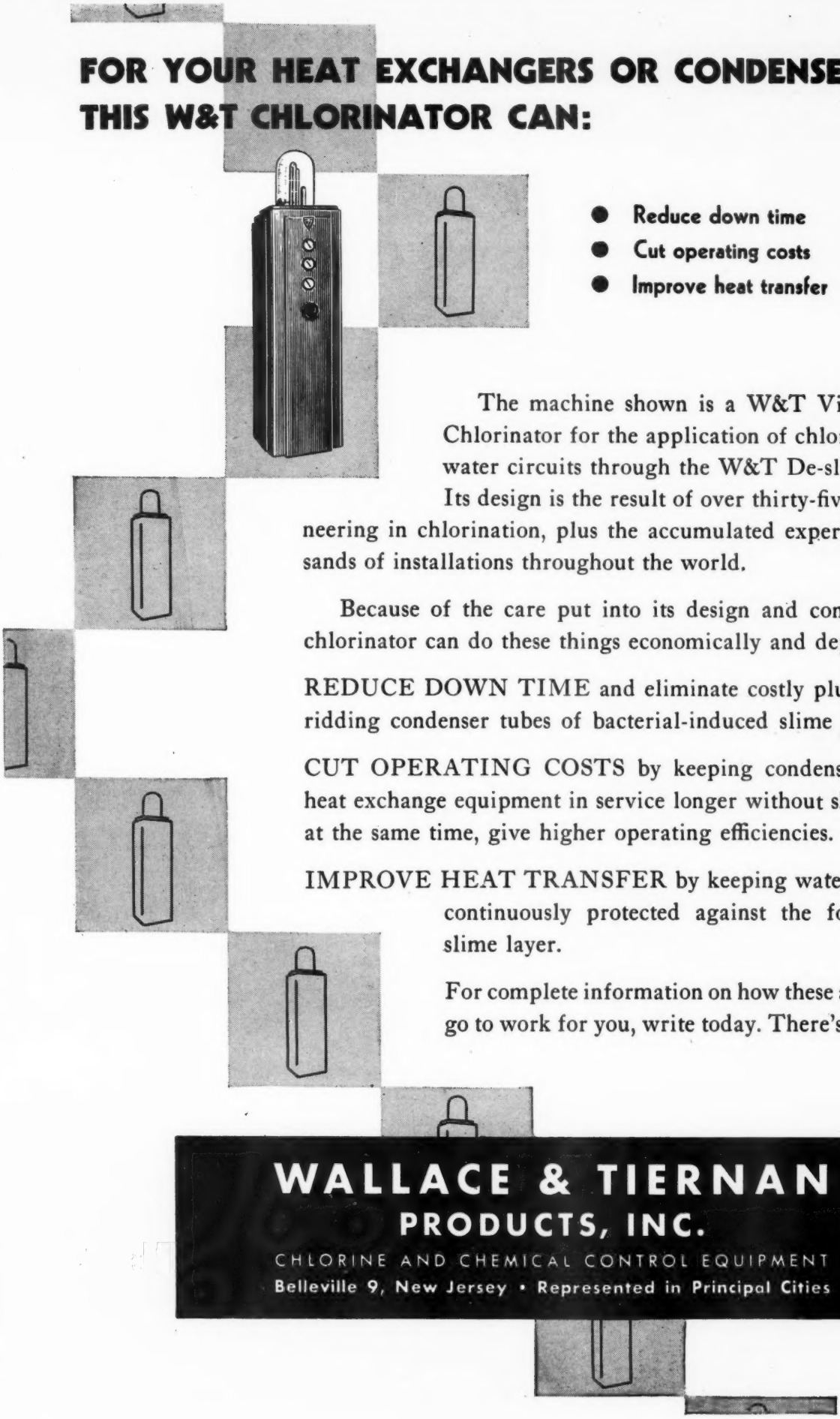
Gordon A Weller is promoted to assistant manager of replacement sales, and Frank A Colosimo is now chief service engineer of American Brakeblok div of **American Brake Shoe Co.** Both men will be located at the division's offices in Detroit, Mich.

Baldwin Locomotive Works, Philadelphia, Pa., has appointed E R Wisner assistant to vice-president in charge of sales, Eddystone div. Walker H Evans succeeds Wisner as manager of Philadelphia district. Also, three officials of Westinghouse Electric have been elected to Baldwin's board of directors. They are A W Robertson, chairman of the board; Gwilyn A Price, president; and L E Osborne, senior operating vice-president. Others elected are James R Weaver, vice-president in charge of manufacturing; John S. Newton, vice-president in charge of engineering; and R Nevin Watt, vice-president in charge of sales.

Ralph M Hoffman continues as president of Link-Belt Co, Pacific div, in addition to having been made a vice-president of the parent **Link-Belt Co,** Chicago, Ill.

Charles C Phelps Co has moved its offices from New York City to 1 Exchange Pl, Jersey City 2, N. J. Phelps represents W H Nicholson & Co, Ellison Draft Gage Co, Leavitt Machine Co, and Perfecting Service Co. C C Phelps, H B Villiers, J F Ryan, P A Ivone and B A Findlow are sales engi-

FOR YOUR HEAT EXCHANGERS OR CONDENSERS, THIS W&T CHLORINATOR CAN:



- **Reduce down time**
- **Cut operating costs**
- **Improve heat transfer**

The machine shown is a W&T Visible Vacuum Chlorinator for the application of chlorine to cooling water circuits through the W&T De-sliming process. Its design is the result of over thirty-five years of pioneering in chlorination, plus the accumulated experience of thousands of installations throughout the world.

Because of the care put into its design and construction, this chlorinator can do these things economically and dependably:

REDUCE DOWN TIME and eliminate costly plug cleaning by ridding condenser tubes of bacterial-induced slime growths.

CUT OPERATING COSTS by keeping condensers and other heat exchange equipment in service longer without shut-down and, at the same time, give higher operating efficiencies.

IMPROVE HEAT TRANSFER by keeping water-side surfaces continuously protected against the formation of a slime layer.

For complete information on how these advantages can go to work for you, write today. There's no obligation.

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● **Instant, handy, safe control of overhead and other out-of-reach valves. Eliminate danger to employees; banish the stepladder. Now — install valves anywhere they should be, regardless of accessibility.**

Inexpensive BABBITT Sprocket Rims fit all types and makes of valves, with either rising or non-rising stems. Installed quickly by clamping directly onto hand wheel of valve. Eliminates makeshift apparatus and specially-made chain wheels.

● Ten standard sizes take care of all valve wheels from 2 to 30 inches in diameter.

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Manufacturers of Adjustable Valve Operating Mechanisms
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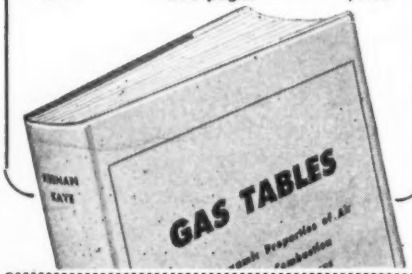
GAS TABLES

Thermodynamic Properties of Air, Products of Combustion and Component Gases, and Compressible Flow Functions

By **JOSEPH H. KEENAN**, Professor of Mechanical Engineering, and **JOSEPH KAYE**, Assistant Professor of Mechanical Engineering; both at Massachusetts Institute of Technology

Save hours of computations with *Gas Tables*, successor to *Thermodynamic Properties of Air*. The authors reexamined and recalculated the properties of air, and added the properties of hydrocarbon combustion products and their constituent gases. Tables of functions for analyzing flow of compressible fluids now cover 30 pages. All values of thermodynamic properties in *Gas Tables* are based on data from spectroscopic sources. Some of the included material has appeared previously only in reports of limited circulation. A book that's useful both in the field and in your engineering library.

1948 **238 pages** **$5.00**



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neers covering metropolitan area, while John Brown, with headquarters at Syracuse, covers central and northern New York State.

Hewitt-Robins Inc named Franklin L Klocke as factory representative for Hewitt Rubber div in North Carolina and Virginia and the Hewitt Restfoam div in the southeast. Also, C W Staacke has joined the staff as technical consultant. Staacke, who will be special assistant to Thomas Robins Jr, president of the company, will maintain his office in the firm's headquarters, 370 Lexington Ave, New York City.

George R Milne is appointed operating manager of **National Carbide Corp** and Russell T Lund, assistant operating manager. Milne continues to have his headquarters at the organization's Louisville plant. Lund will have his office at the Ivanhoe, Va., plant for the present.

Airco Export Corp, subsidiary of Air Reduction Co, has changed its name to Airco Corp (International).

Lyle A Christensen, general sales manager of **Marley Co,** Kansas City, Kansas, is now a vice-president of the company.

Atlas Chain & Mfg Co, Philadelphia, made O W Schmidt Central States district sales manager. Schmidt will maintain offices in Chicago.

Howard C La Mere is in Chicago now at 205 W Wacker Drive, handling the **Automatic Control Co** line in that area.

Merrill Co, San Francisco, Calif., announces incorporation of a subsidiary, Merrill-Brose Co. Among major lines of equipment represented by Merrill-Brose are: Cleaver-Brooks Co, Abbe Engrg Co; Browning Crane & Shovel Co, Pennsylvania Pump & Compressor Co, and Yeomans Brothers Co. George Brose, vice-president, will be general manager of the new subsidiary.

Carl F Norberg has been elected a director of **Electric Storage Battery Co,** Philadelphia to fill the vacancy caused by retirement of Frank T Kalas. Norberg is granted executive authority and vested with power to perform duties of the president or executive vice-president in the event of their absence or inability to act. Also, Roland Whitehurst becomes vice-president in charge of sales.

Dr John G Dean became head of industrial chemicals section, development and research div of **International Nickel Co,** New York City.

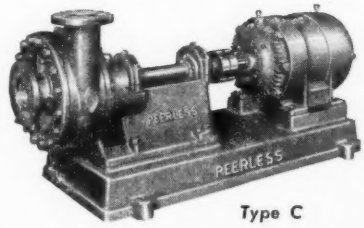
United States Air Conditioning Corp, Minneapolis, has acquired Great National Air Conditioning Corp, Dallas, Texas, as a subsidiary. Don Groth will serve as general sales manager of Great National with offices in Oklahoma City.

General Controls Co appointed B L Lerch factory branch manager of the new St. Louis office, which will serve the eastern half of Missouri, southern Illinois, southwestern Indiana, western Tennessee, north-

TYPE C

PEERLESS *Centrifugal* PUMPS

FOR PROCESS SERVICES



Type C

TYPE C ENCLOSED IMPELLER

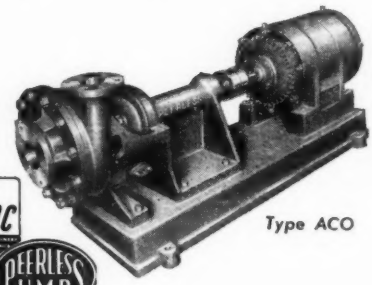
Designed to handle clear liquids which can be of corrosive nature. Single-stage, single-end suction design; range of capacities from 10 to 1200 g.p.m.; heads up to 231 feet; maximum working pressure of 150 lbs.

TYPE CO OPEN IMPELLER

Utilizes an open impeller to permit pumping of fluids up to 750° F with solids in suspension, brines, sludges, etc. Capacities from 10 to 1200 g.p.m.; heads to 231 feet; maximum working capacity of 150 lbs. All forms of drive. Both of the above pumps are described in Bulletin 810.

TYPE ACO FOR ACIDS AND CAUSTICS

Especially designed to pump caustics and acids. Handles fluids up to 800 g.p.m.; heads to 231 feet; maximum working pressure of 150 lbs. Temperatures should not exceed 300° F. Described in Bulletin D-2400.



Type ACO

fmc PEERLESS PUMPS

PEERLESS PUMP DIVISION
FOOD MACHINERY & CHEMICAL CORPORATION
Factories: Indianapolis, Ind.; Los Angeles 31, Calif.
District Offices: New York 5, 37 Wall Street; Chicago 40, 4554 North Broadway; Atlanta Office: Rutland Building, Decatur, Georgia; Dallas 1, Texas; Fresno, California; Los Angeles 31, California.

Why do "Buffalo" FANS handle the BIG Jobs Better?

A "Buffalo" Fan to be installed in a large processing plant.

It's easy to see that they DO—check the preferences of consulting and industrial engineers on the BIG jobs all over the continent, and you will find "Buffalo" the outstanding first choice.

As to WHY "Buffalo" Fans are preferred, there are three good reasons:

1. **"Buffalo" builds "heavy-duty" fans for industry; light-weight construction is not part of our line.**

2. **"Buffalo" Sales Representatives are graduate engineers, with years of factory training before their selling careers start. They KNOW Fans, and your industrial application problems.**

3. **The seventy-year old "Buffalo" organization has specialized for more than fifty years in industrial fan applications.**

And, of course, there's a fourth reason which is important on big fans—that's efficiency—which means less horsepower to do the job.

When you specify "Buffalo" you're getting the best. Sales Representatives in all principal cities.

BUFFALO FORGE COMPANY

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FANS by "Buffalo"

EQUIPMENT FOR

- ★ VENTILATING
- ★ HEATING
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- ★ PROCESS COOLING
- ★ AIR TEMPERING
- ★ AIR WASHING
- ★ EXHAUSTING
- ★ BLOWING
- ★ FORCED DRAFT
- ★ INDUCED DRAFT
- ★ PRESSURE BLOWING
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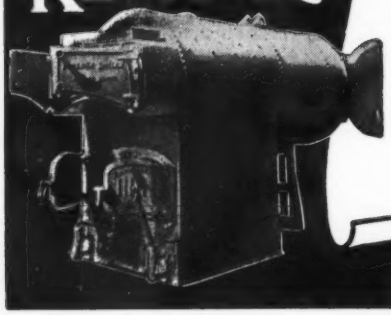
Extra STRENGTH for Heavy Duty

KEWANEE



● Backed by more than 75 years of boiler building experience Kewanee Heavy Duty types have all the characteristics which make firebox boilers ideal for high pressure.

10 to 304 H.P.
100, 125, 150 lbs. W. P.

Built of steel with extra stout stays and braces to add further strength.

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KEWANEE, ILLINOIS
Division of American Radiator & Standard Sanitary Corporation

BE SURE YOU HAVE EXTRA GAUGE GLASSES
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Exclusive Features of Corning Gauge Glasses

1 PERFECT VISIBILITY—PYREX and CORNING brand gauge glasses are crystal clear. Water level is always easy to see. PYREX red line gauge glass magnifies the water level.

2 LONG SERVICE LIFE—Because of their composition and method of manufacture, PYREX and CORNING brand glasses withstand expansion, contraction and physical shock to a greater degree than any other glass.

3 EASY TO INSTALL—Accurately controlled manufacture assures uniformly close tolerances for accurate fit.

4 MEET ALL SERVICE CONDITIONS—Whether your pressure requirements are high or low, Corning has the gauge glass that will meet them.

When you need gauge glasses, you need them quick. Low water in your boiler, for example, could cause damage costing real money. But a broken gauge glass wouldn't reveal the danger. There isn't any economy in being without spares. There just isn't any economy in being without Corning products. They provide the most dependable service at the lowest possible cost.

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TECHNICAL PRODUCTS DIVISION: GAUGE GLASSES • GLASS PIPE • LIGHTINGWARE SIGNALWARE • LABORATORY GLASSWARE • OPTICAL GLASS • GLASS COMPONENTS

eastern Arkansas and northern Mississippi. O D Shaddox, as factory branch manager of the new Oklahoma City office, will be in charge of Oklahoma and all but the northeastern part of Arkansas territory.

Ernest H Lauter and George Omelianoff have organized the **Progressive Welder Sales Co of Ohio** to handle sales of resistance welding equipment in eastern Ohio, western Maryland, western Pennsylvania and northern section of West Virginia. Headquarters is at 5713 Euclid Ave, Cleveland.

Viking Products Co, Detroit, Mich., a new company organized to produce automatic air valves, has completed its developmental program and installation of equipment for mass production at its Vicksburg, Mich., plant. William R Allen is sales manager.

J H Deppeler was granted a leave of absence from his position as chief engineer of **Metal and Thermit Corp** to permit him to establish his own office, at 36 W 40th St, New York City. As a consulting engineer on welding and related problems, he plans to help individuals or firms with welding problems, and to assist their legal counsel in event of litigation.

M A King has rejoined **Elliott Co** as engineering vice-president, Jeannette div.

Refrigeration Equipment Mfrs Assn elected W A Siegfried to fill the unexpired term of G M Kingsland as secretary. Siegfried is president of Superior Valve & Fittings Co, Pittsburgh, Pa.

S L Nevins has joined **Mathieson Chemical Corp,** New York City, as general manager of the organization's newly formed ammonia dept.

American Institute of Electrical Engineers names Charles S Rich to succeed G Ross Henninger, who has resigned, as editor of the institute's official publications, Electrical Engineering and Transactions.

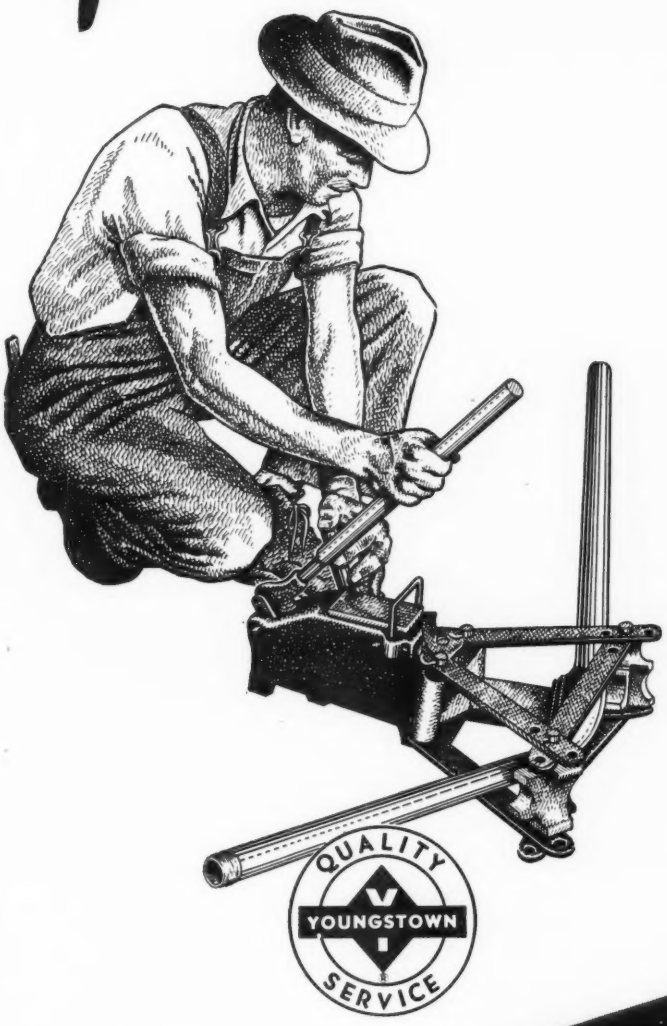
Refrigeration Equipment Mfrs Assn announces appointment of W Vernon Brumbaugh as executive secretary to succeed R K Hanson, who has resigned. Brumbaugh will be at the headquarters office of REMA, 1107 Clark Bldg, Pittsburgh, Pa.

John H Olson has become a member of the business department of **Burns & Roe, Inc,** New York City.

Dr G E F Lundell has retired from active duty as chief of chemistry div of **National Bureau of Standards** and Dr Edward Wichers becomes div chief. Lundell will remain on the staff as consultant. Dr William Blum has been made assistant chief.

Newly formed Utah Chapter of **American Society for Metals** is the 77th chapter to join the national organization devoted to services to the metals industry. W C Dyer, supt, metallurgical, chemical and inspection dept, Geneva Steel Co, is elected chair-

Yes, it's Youngstown!



Dependable Steel Pipe
The Pipe-Fitters Friend

FOR 45 years, Youngstown Steel Pipe has served plumbing and heating contractors dependably--enabling them to furnish adequate water and heating systems to customers at lowest cost.

Whether you use a few feet or thousands of miles of Youngstown Steel Pipe, you can depend on its uniformity--uniform in metallurgical and chemical properties for easy, accurate bending, cutting, welding and threading--uniform in diameter and roundness--cut to uniform lengths--uniformly smooth inside for minimum friction--in short, *uniformly satisfactory.*

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THE YOUNGSTOWN SHEET AND TUBE COMPANY
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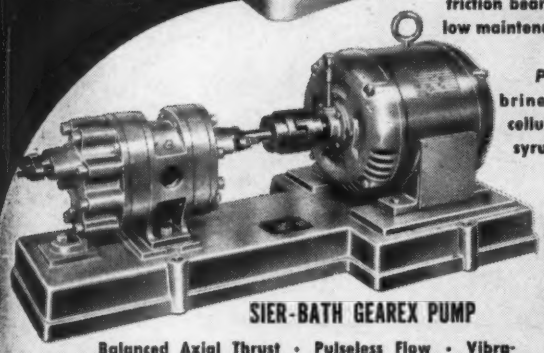
For { LOWER COST... MORE EFFICIENT PUMPING

specify SIER-BATH ROTARY PUMPS

SIER-BATH SCREW PUMP

Advantages: • pulseless flow • anti-friction bearings • vibrationless operation • low maintenance cost • rugged construction.

Pumps: Acetate, asphalts, brines, Bunker C Fuel Oil, cellulosics, greases, molasses, syrups, lube oils, etc.



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Balanced Axial Thrust • Pulseless Flow • Vibrationless Operation • Roller Bushings for Precision Running under load.

Pumps: Oils, Varnishes, Solvents, Molasses, Chemical Solutions.

Capacities: 1-550 g.p.m.

Discharge: 250 p.s.i. for medium or high viscosities. 50 p.s.i. for water.

MADE BY ROTARY PUMP SPECIALISTS

SIER-BATH Screw Pumps and Gearex Pumps are made in a plant keyed to precision methods of gear manufacturing. Our engineers have a long background of experience specializing in the design of rotary pumps. As a result, the high quality of these pumps enables them to operate for long periods without maintenance. Their pulseless flow and vibrationless operation mean less wear on valves, couplings and other fittings. Pipes and joints remain tight. In every way, the Sier-Bath Screw and Gearex Pumps are constructed to render reliable and continuous service, with least possible maintenance. Write for detailed information.

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man. Don Rosenblatt, chief metallurgist, American Foundry & Machine Co, is chosen vice-chairman. Dr H Edward Flanders, professor of metallurgy, University of Utah, is named secretary-treasurer. Executive committee also includes Dr John R Lewis, professor and head of metallurgical engineering, University of Utah; Hugh M Thomson, assistant chief engineer, Utah Oil Refining Co; A N Hopper, plant manager, Salt Lake City Works, Chicago Bridge & Iron Co; Robert J Prout, supervisor, metallurgical lab, Geneva Steel Co; A P Hoelscher, asst supt industrial relations, Geneva Steel Co; and W H Mathesius, asst supt open hearth dept, Geneva Steel Co.

Savannah Electric & Power Co elects L C McClurkin, president, to replace Claude C Curtis. Having reached retirement age, he has resigned.

Theodore C Gams, consultant in industrial electronics, is appointed director of **School of Industrial Technology,** New York City.

Illinois Institute of Technology has elected to membership on the board of trustees Robert H Morse Jr, vice-president of Fairbanks, Morse & Co, and Ludwig Skog, senior partner of Sargent & Lundy, Chicago firm of consulting engineers.

OBITUARIES

Thomas R Warren, 65, senior stationary engineer at Municipal Bldg, Batavia, N. Y., died Sept. 27. He had been associated with the city for 35 years.

John D Fleming, 58, member of organic sales development department of Monsanto Chemical Co, died Oct 12 from a heart attack at his home in St Louis.

Dr William Roth Work, 67, assistant director of College of Engineering and Science, Carnegie Institute of Technology, Pittsburgh, Pa., died Oct 3.

Arthur H Wyman, 65, manager of Allis-Chalmers general machinery district sales office at Cleveland, Ohio, died Oct 5 in that city.

George Edward MacMannus, 68, electrical engineer, died Oct 6 at his home in West Hartford, Conn. He had retired last March from Federal Electric Products Co, Newark, N. J.

Henry G Baist, 62, stationary engineer for American Brewing Co, Rochester, N. Y., died in his home Sept 22.

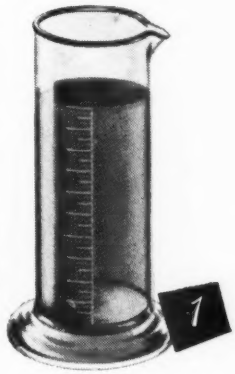
Herbert J Hall Sr, 72, stationary engineer of Niagara Falls, N. Y., died Oct 4 after a short illness.

I E Wilson, 81, an engineer on power-plant construction of General Electric Co for 36 years, died Oct 10 at Somerville, Mass. He retired 16 years ago.

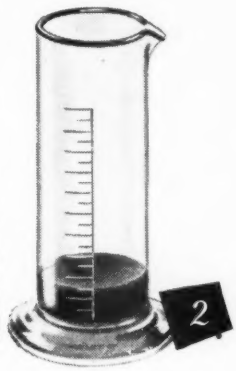
The *inside story* of outstanding performance

Gulfcrest is the only turbine oil that's Alchlor-processed.* This is an extra refining step. It makes Gulfcrest extra pure and extra efficient.

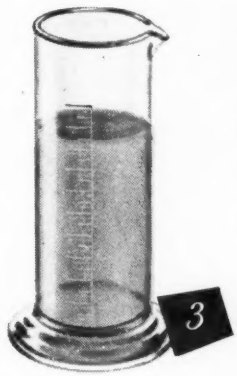
In Cylinder 1 you see the oil that will become Gulfcrest. It has already gone through the usual steps used in refining most other turbine oils—but has not yet been Alchlor-processed.*



In Cylinder 2 you see the part—approximately 15%—discarded by the Alchlor Process* This is the part that, when allowed to remain in turbine oil, is most likely to oxidize, increase neutralization number, and form sludge, emulsifiers, and harmful acids.



In Cylinder 3 you see the finished Gulfcrest — the incomparably pure lubricating oil that gives outstanding performance and helps you keep steam turbine systems clean indefinitely. To make it even finer, special inhibitors are added to it—they give it still greater stability and protection against corrosion.



GULFCREST

is the only turbine oil that gets this

extra refining*

Call in a Gulf Lubrication Engineer today and ask him to recommend the proper grade of Gulfcrest Oil to meet the specific requirements of your turbines. Write, wire, or phone your nearest Gulf office.

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which pump?

When you buy a pump you naturally expect good service, dependable operation, low power and maintenance costs and other benefits. The question is—which pump will give you these benefits in greater measure?

To help you answer this question read the clear statements about our Company and our products — draw your own conclusions.

1. Warren is backed by 50 years experience in building pumps.

2. Warren builds pumps *exclusively*. Our reputation is based *entirely* upon our ability to build pumps.

3. Warren builds practically *all types* of centrifugal and reciprocating pumps and will engineer special pumps for special purposes.

4. Warren ranks well among pump builders as to size, organization and facilities.

5. Warren bows to no one in selecting the right pump for the job. "A Warren recommendation is never a compromise."

6. Our customers include many of the famous names throughout industry.

7. Warren pumps are fairly priced—but not built to a price. Initial cost is insignificant when measured against results.

8. Warren pumps are guaranteed—not only as to quality and workmanship, but also for performance as rated when shipped. Maintained efficiency is inherent in every Warren design.

Why not put your pump problems up to Warren?

WARREN PUMPS

Reciprocating and Centrifugal

WARREN STEAM PUMP CO., INC., WARREN, MASS.

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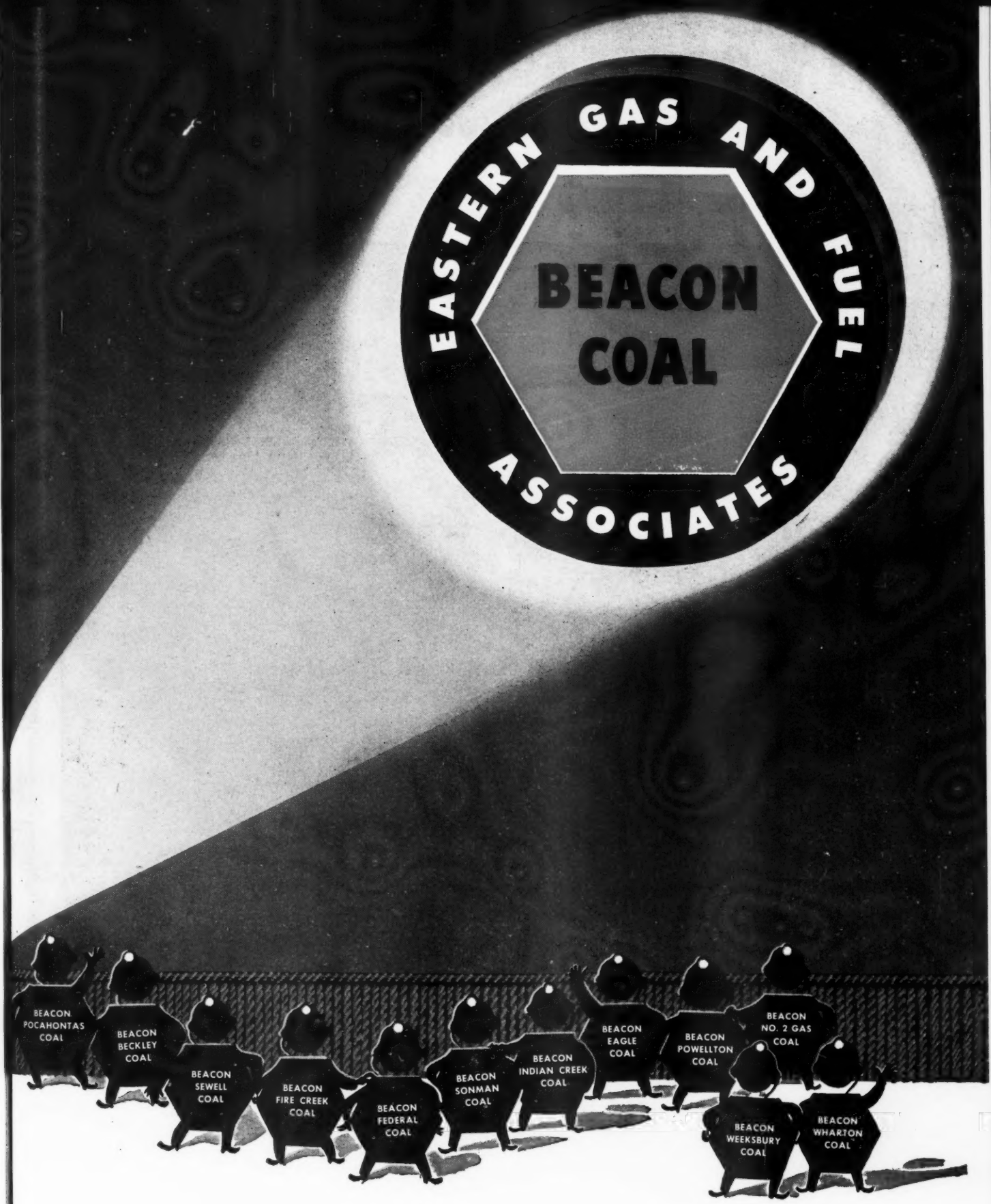

EASTERN GAS AND FUEL ASSOCIATES

COAL DIVISION

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K&M "Century" Asbestos Corrugated

for long life without maintenance...

The "new" roof on this industrial building is actually more than 3 decades old! A coal operator installed these "Century" Asbestos Corrugated sheets on a coal tipple 33 years ago before he re-used them here.

for modern architectural effect...

Beauty in typically modern style is brought to this store with a facade of "Century" Asbestos Corrugated. This beauty will *last* without any painting or other expensive upkeep.

You've probably noticed that "Century" Asbestos Corrugated is growing in popularity for decorative motifs... inside and outside... for industrial plants, stores, restaurants, theaters. There's a rugged attractiveness in the simplicity of the corrugations and neutral light-gray coloring.

And perhaps it's no news to you that "Century" Asbestos Corrugated is thoroughly practical from the *structural* point of view. It actually *toughens* with age. Never needs to be painted. Can't rot, corrode, catch fire, or succumb to termites.

NEW "TOP-SIDE" FASTENERS CUT ROOFING COSTS

On top of all this, you can specify the new "TOP-SIDE" Fasteners, and cut a big slice off the cost of roof installation over steel purlin construction. Exclusive with "Century" Asbestos Corrugated, these new fasteners permit roofing to be done entirely from *atop the roof* ... eliminating entirely the costly labor and scaffolding normally required beneath. This feature, alone, is worth looking into—write us for full details.

Nature made Asbestos... Keasbey & Mattison has made it serve mankind since 1873

DIAMOND ANNIVERSARY 1873 K&M 1948 KEASBEY & MATTISON CO.

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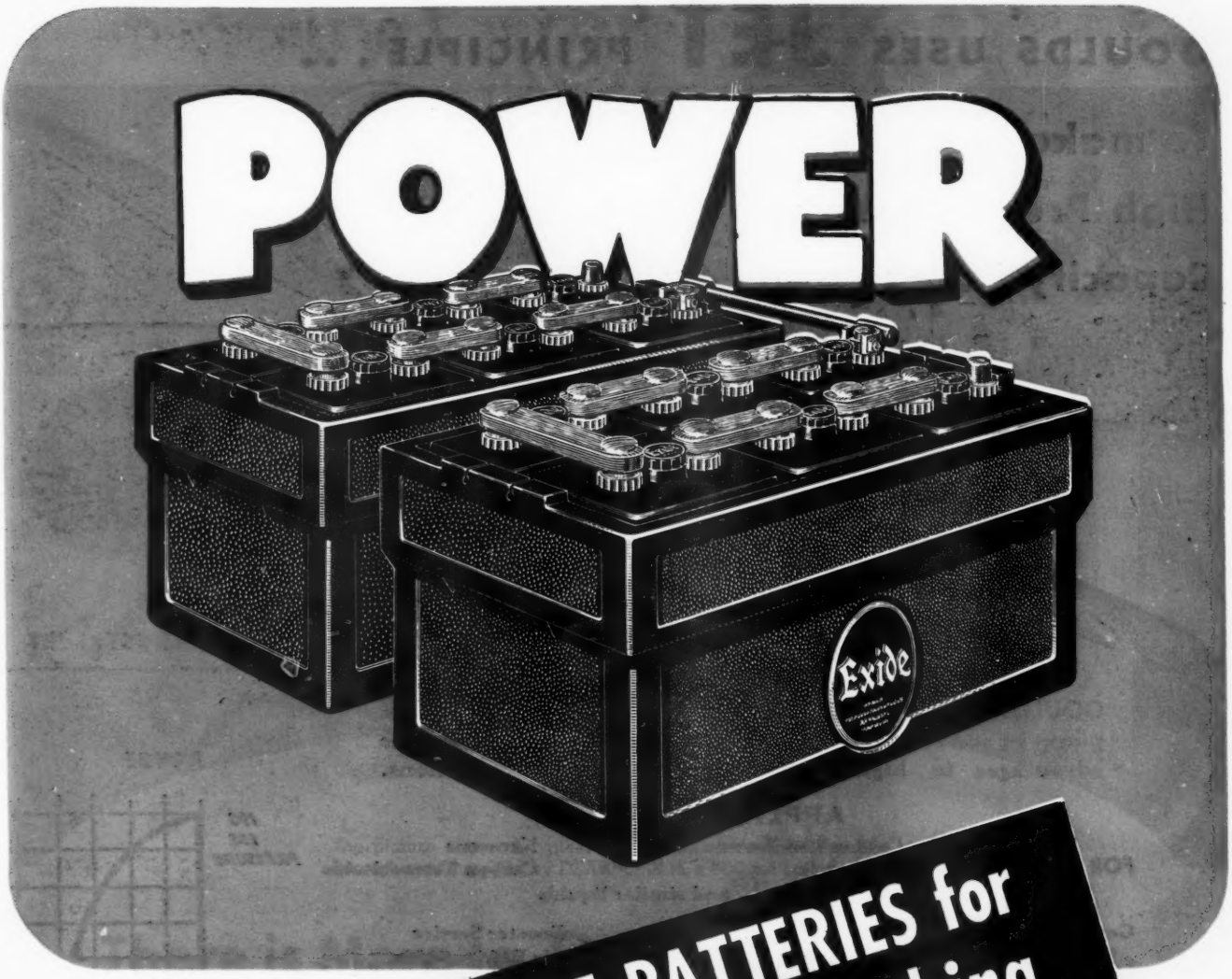


Rely on EXIDE BATTERIES for dependable Diesel cranking

Exide Batteries in Diesel-powered equipment assure dependable cranking performance . . . in all weather . . . in all climates. They're built specifically to do even the toughest cranking jobs . . . with extra power and efficiency . . . day after day . . . year after year.

Exide Batteries are cranking Diesel engines on trucks, buses, off-the-highway equipment, ships, railroad locomotives, in power plants and many other applications. For dependable performance, long life and ease of maintenance, specify Exide Batteries.

Exide
BATTERIES

1888...Dependable Batteries for 60 Years...1948

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32 • *Exide Batteries of Canada, Limited, Toronto*

GOULDS USES JET PRINCIPLE . . .

To make New, Better High Pressure, Low Capacity Pump

INDUSTRI-JET

GOULDS has combined a centrifugal and a jet or ejector type pump in one compact unit. This new pump gives you unique advantages in high pressure—low capacity applications.

APPLICATIONS

FOR HANDLING { Cold or Hot Water, Alcohol, Kerosene, Carbon Tetrachloride and similar liquids

General Water Supply
Condensation Return
Filter Press Service
Air Conditioning
Spraying
Boiler Feeding
Booster Service
Air Refrigeration
Hot or Cold Circulating Service

ADVANTAGES

IN PERFORMANCE

1. *Self Priming*—can't vapor lock. Once primed, always primed. The Industri-Jet automatically recovers prime even after suction is exposed to atmosphere.
2. *Built for continuous service.*
3. *Handles both wet and dry liquids.*
4. *Smooth, quiet operation—steady flow.*

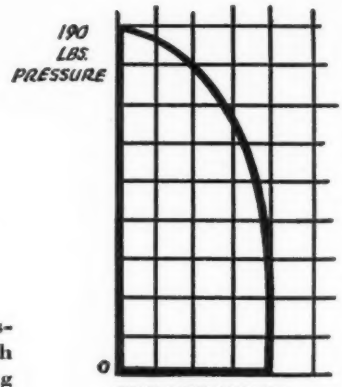
IN MAINTENANCE

1. *Freedom from wear—long life.* Industri-Jet uses the Jet principle for high pressure. There are no close running fits or clearances. The only moving part is the rotating impeller and shaft.
2. *Mechanical seal needs no attention.* Self-Adjusting for wear, requires no lubrication.
3. *Easy to inspect.* Entire pump can be disassembled without disturbing suction or discharge connections.

IN COST

Initial cost is low—and lower still when you consider quality construction and the many operating advantages.

RANGE



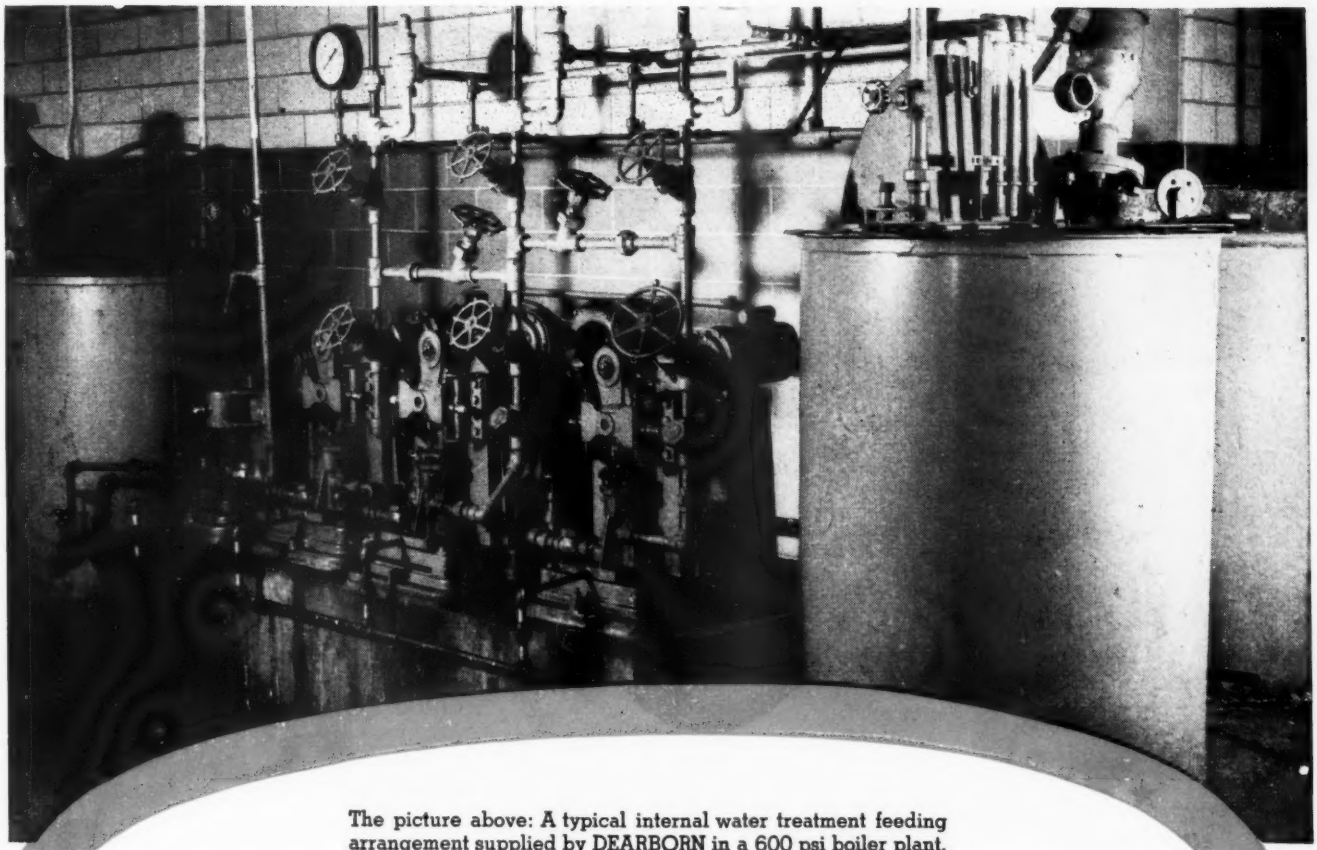
Nine Sizes, ¼ HP to 5 HP
Capacities: to 35 GPM
Pressures: to 190 lbs.

GOULDS

Write Goulds Pumps, Inc., Seneca Falls, N. Y., for complete information on this new pump. Ask for bulletin 630-A1.

PUMPS, INC.

the PUMP FOR the JOB



The picture above: A typical internal water treatment feeding arrangement supplied by DEARBORN in a 600 psi boiler plant.

There is More to *Dearborn* Engineering Than Treatment

This installation consists of four high-pressure pumps, one of which is used to introduce corrective treatment continuously through the boiler water feeding system for the purpose of controlling scale deposits and corrosion. The other three adjustable stroke pumps are used to introduce a second type of treatment into three high-pressure boilers, the treatment solution going directly into the boiler drums.

Treatment formulations were determined after a complete plant survey by Dearborn engineers and in collaboration with the laboratory technicians.

The treatment solutions, according to laboratory specifications, are prepared at the required intervals in mechanically-agitated chemical tanks.

This method of application insures correct chemical balances in the boiler water at all times, providing great flexibility, and making possible any adjustments which may be necessary, based on make-up water requirements.

Dearborn treatment feeding equipment is designed for plants of all sizes—Consult Dearborn engineers for recommendations.

Dearborn
TRADE MARK REGISTERED

The Leader IN BOILER WATER TREATMENT AND RUST PREVENTIVES

SAY BADGER AND BE SURE OF THESE EXCLUSIVE FEATURES★

★ALL-CURVE CORRUGATIONS

★ALL-CURVE DIRECTED FLEXING RINGS

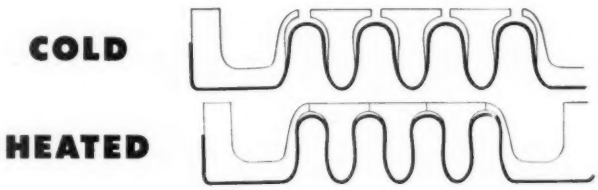
E. B. Badger & Sons Company is the original and sole manufacturer of BADGER Expansion Joints

Only in Badger Packless Corrugated Expansion Joints can you get these two important advantages.

Badger Joints are designed so that all points of the surface of each corrugation share that corrugation's individual load equally and all the corrugations share the stress load equally. There are no pockets or junctions in which stresses can localize. Stresses can't pile up unevenly among the corrugations. These facts add up to better, stronger, longer lasting expansion joints.

Badger Expansion Joints are compact and easy to install too. One-piece construction eliminates re-packing and servicing; maintenance costs go tumbling.

Badger Packless Corrugated Expansion Joints are made in copper, stainless steel and other alloys, with rings (Self-equalizing) or without rings (Non-equalizing), depending upon requirements. For complete information, simply send for Bulletin No. 100 (Self-equalizing) or No. 200 (Non-equalizing).



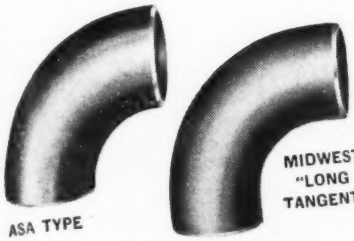
Badger

E. B. BADGER & SONS CO., Cambridge Division, 260 Bent Street, Cambridge 41, Mass.
AGENTS IN PRINCIPAL CITIES

PACKLESS CORRUGATED EXPANSION JOINTS

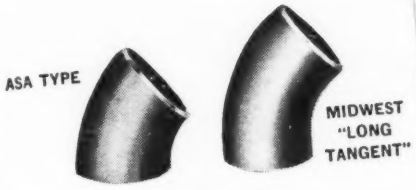
IMPROVE PIPING DESIGN and REDUCE COSTS with...

...MIDWEST WELDING FITTINGS



90° ELBOWS

REDUCING ELBOWS

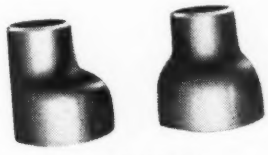


45° ELBOWS

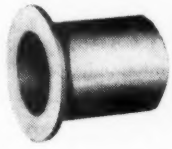
180° RETURNS

TEES

REDUCING-ON-RUN TEES



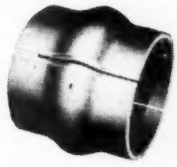
REDUCERS



LAP-JOINT STUB ENDS

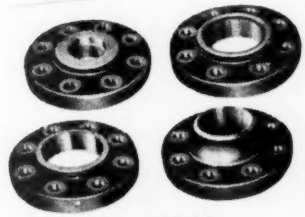
CAPS

SADDLES



SLEEVES

SHAPED NIPPLES



FLANGES

To simplify and improve piping design, Midwest originated and developed many of the fittings shown here. For example: the Midwest Reducing Elbow (available in sizes including 12") decreases turbulence and pressure drop when used instead of a standard elbow and a reducer; more than one third of the welding is also saved. Midwest Long Tangent Elbows save pipe and time in lining up. Midwest Saddles compensate for weakening of header body resulting from metal removed for nozzle opening. Midwest Welding Fittings stocks are carried in all principal cities . . . get in touch with your distributor.

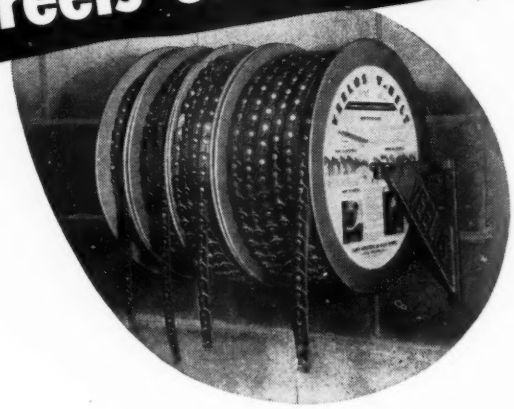
MIDWEST PIPING AND SUPPLY COMPANY, Inc.

Main Offices: 1450 South Second Street, St. Louis (4), Mo.

Sales Offices: New York (7), 30 Church St.
Chicago (3), 79 West Monroe St. • Los Angeles (33), 520 Anderson St. • Houston (2), 229 Shell Bldg.
Tulsa (3), 533 Mayo Bldg. • South Boston (27), 426 First St. • Distributors in Principal Cities.

Everyone of these v-belt sizes

can be replaced with 4 reels of Veelos



No matter how big your present V-belt inventory, you can drastically cut it with just 4 reels of Veelos. These handy reels give you a choice of more than 316 sizes in O, A, B and C widths. If you use only A and B sizes, just 2 reels of Veelos will provide you with a complete V-belt inventory. Any length belt is quickly uncoupled from a reel, made endless, then installed.

As soon as you specify Veelos on reels, you can stop stocking matched sets of endless belts. You can forget belt deterioration and obsolescence. Veelos on reels saves storage space .. simplifies inventory records.

Veelos goes on fast . . . lowers machine downtime. On drives with outboard bearings it is installed without moving the motor or dismantling the machine. Veelos is made in all standard sizes . . . fits all standard grooves . . . is available in 100 foot reels. Sales engineers in principal cities; over 300 distributors throughout the country.

VEELOS
THE LINK
V-BELT

New Veelos Catalog... How Veelos on reels makes big V-belt inventories little is just one of the many features in the new Veelos catalog. All the facts and full engineering data are given. Write for your copy today.

MANHEIM MANUFACTURING & BELTING COMPANY
MANHEIM, PENNSYLVANIA

VEELOS is known as VEELINK outside of the United States

ADJUSTABLE TO ANY LENGTH • ADAPTABLE TO ANY DRIVE

I KEEP OUT DIRT and WATER

"I am De Laval Centrifugal Force. When I am put to work to purify lubricating oil — either turbine lube or Diesel lube — I do more than just remove the ***dirt*** present in the oil. I take out ***water***, too!"

That's where De Laval Centrifugal Force differs from other means of maintaining lubricating oil. It does its job ***completely***—the protection it affords against trouble from impurities remaining in lubricating oil is ***complete*** protection. No half-way measures for De Laval Centrifugal Force — the water is discharged continuously after being centrifuged out, and the dirt is stored outside of the zone where purification takes place.

De Laval Oil Purifiers have another advantage — enough reserve capacity to take care of a sudden emergency, such as a surge of water due to a leak.

Write for additional information.

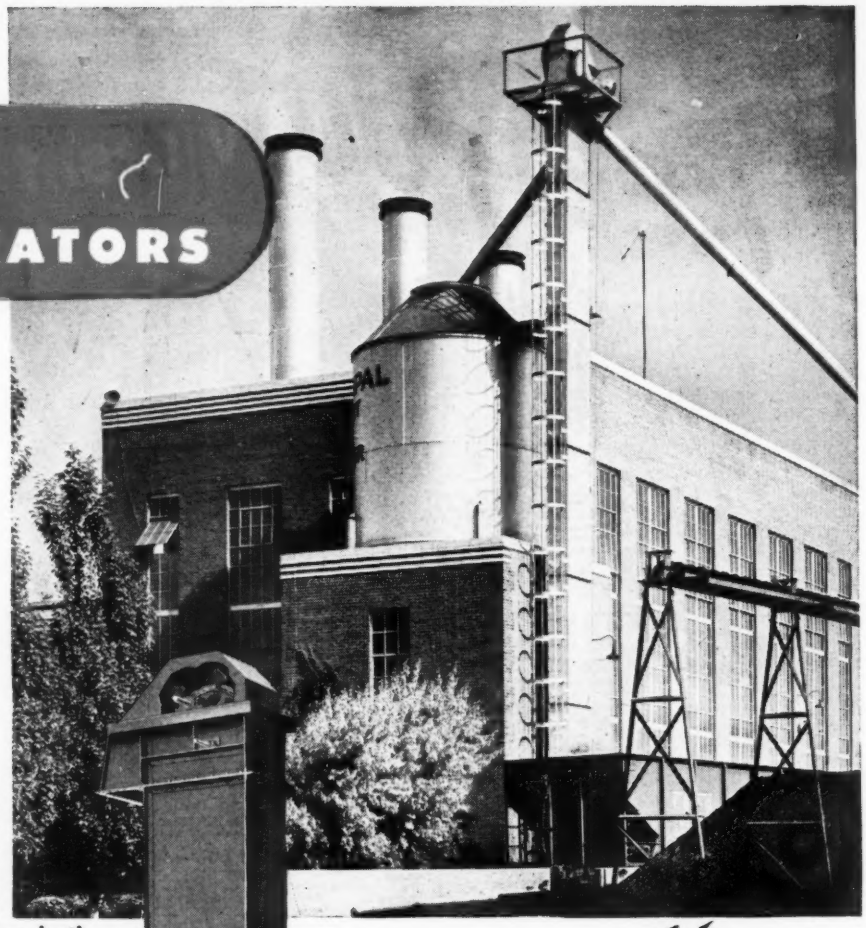
THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL

OIL PURIFIERS

for more dependable power production

STANDARD BUCKET ELEVATORS

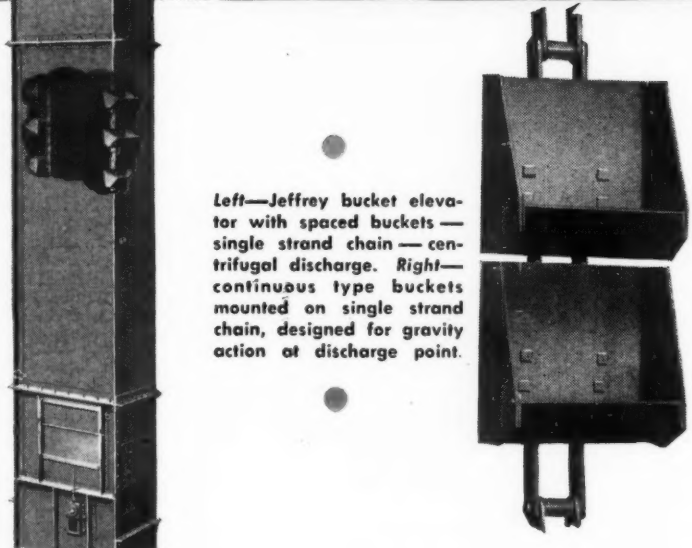


COAL and ashes handled — at low cost — minimum of space. Bucket Elevators — spaced or continuous buckets—of *standardized design*. In small plants — a complete system. The modern plant (see photo above) utilizes a silo which provides both a live and dead storage of large capacity.

Jeffrey bucket elevators have rigid angle construction — casing of heavy gauge steel — removable head — dust tight stuffing boxes on both head and countershaft — cut gears and chilled sprockets — standard HD journal bearings and steel boot — cleanout doors both sides.

SUPERMAL buckets if desired. Buckets mounted on single or double strand chain — or belt.

Send for Catalog No. 778-A which goes more into detail.



Left—Jeffrey bucket elevator with spaced buckets — single strand chain — centrifugal discharge. *Right*—continuous type buckets mounted on single strand chain, designed for gravity action at discharge point.

Track hoppers • feeders • distributing conveyors • weigh larries • skip hoists crushers • bin valves • chutes • car spotters

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ESTABLISHED 1877

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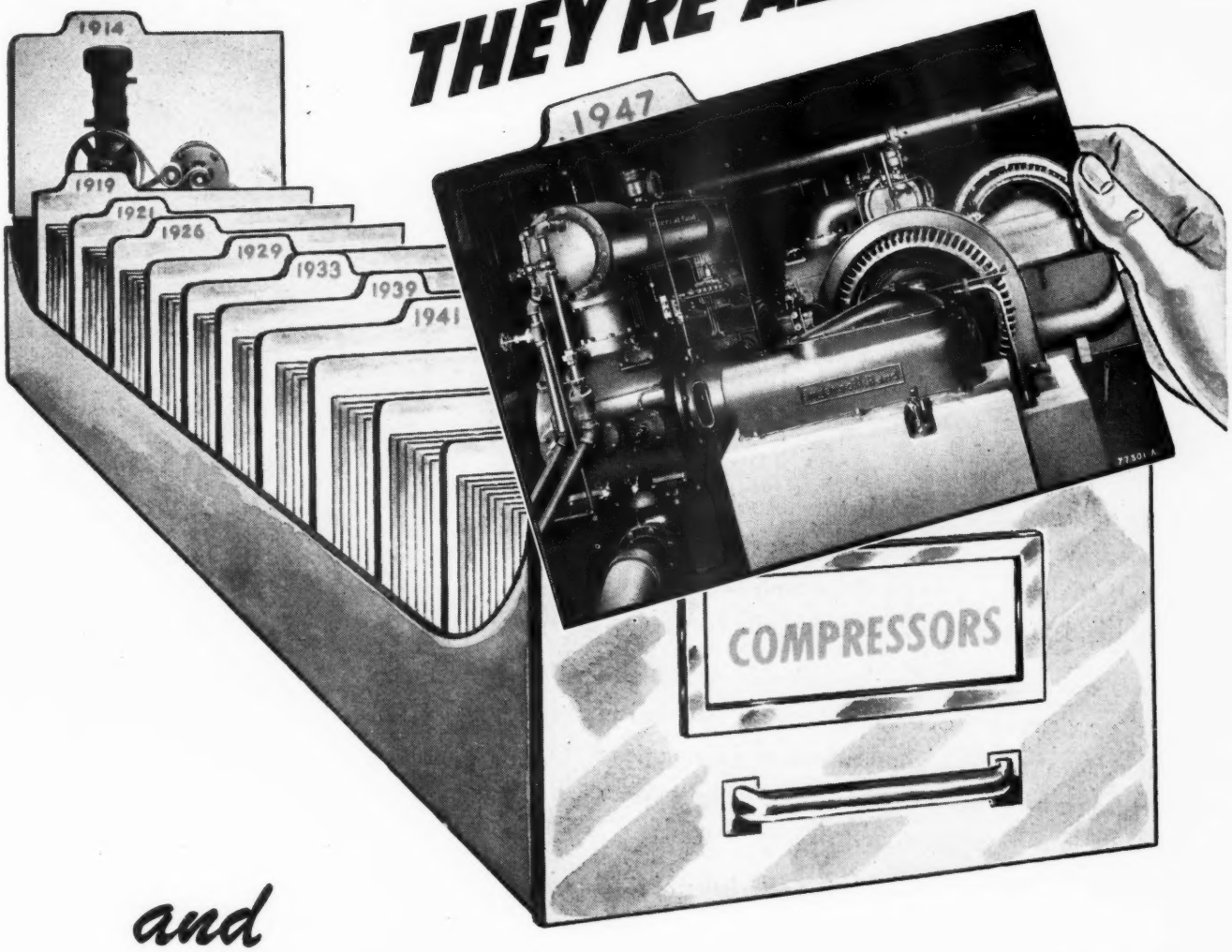
Complete Line of Material Handling, Processing and Mining Equipment

THEY'RE ALL I-R



and

ALL OPERATING TODAY!

34 YEARS of trouble-free service...and still in daily use. That's the record of a Wisconsin manufacturer's first Ingersoll-Rand compressor, installed in 1914.

Many times since then more capacity was needed. Each time another compressor was installed it was an I-R. Today there are 12 of them, newest of which are three Type XRE, direct-connected, synchronous-motor-driven units. From experience, this manufacturer knows that Ingersoll-Rand compressors are economical, dependable, and long-lasting.

It is interesting to note that all these compressors were purchased through the same I-R Engineer. In each case his knowledge and experience played a major part in the selection of the proper machine for the job.

When you need Air-Power, let one of our trained engineers give you the same help with your problems.

COMPRESSORS • AIR TOOLS
ROCK DRILLS • TURBO BLOWERS
CONDENSERS • CENTRIFUGAL PUMPS
OIL AND GAS ENGINES

Ingersoll-Rand

11 Broadway, New York 4, N. Y.

184-1

K-68...

an outstanding

sheet packing

K-68 gives outstanding results where unusual resilience must be combined with resistance to oil and to extremely high temperatures. K-68 sheets are made of specially selected asbestos fibres and bonded under great pressure with Neoprene.

K-68 sheets are recommended for aviation and Diesel engines and applications in oil refineries and chemical plants where they must stand up against solvent and aromatic conditions at extreme heat. Because K-68 contains no sulphur it is also valuable in refrigeration service.

For applications where the special characteristics of K-68 are not required, R/M offers a number of other sheet packings, among which are R/M No. 650, the famous "Pyroid" brand; R/M No. 670, which is approved by the National Board of Fire Underwriters.

For all your sheet or other packing needs see your authorized R/M distributor.

RAYBESTOS-MANHATTAN, INC.

ASBESTOS TEXTILE & PACKING DIVISION

Manheim, Pa. • Bridgeport, Conn. • North Charleston, S. C. • Passaic, N. J.

We also manufacture a complete line of Asbestos Textiles, Friction Materials, and Industrial Rubber Products.

STANDARD ENGINEER'S REPORT

RPM CALOL

TEST DATA

UNIT G.E. 50,000 KW Steam Turbine - ~~Horiz. Steeple Compound.~~ Steam - 1250 lbs. - 750° F.

LUBRICANT Calol OC Turbine Oil - 9

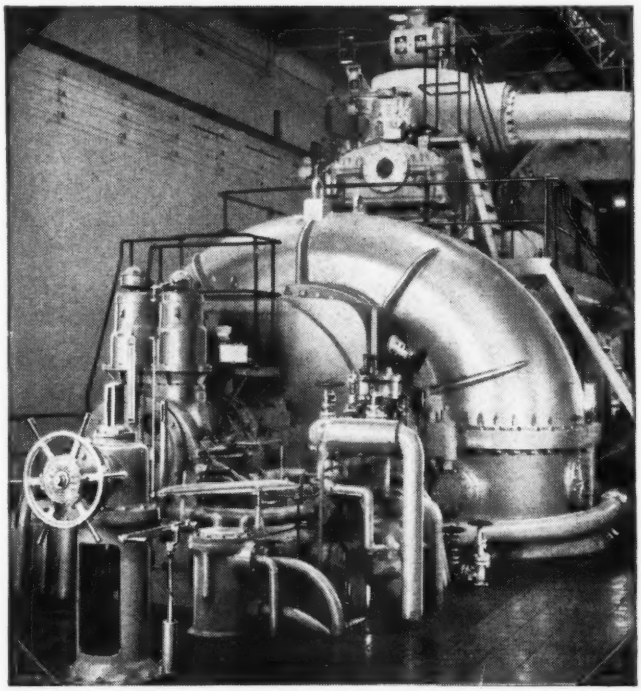
TEST PERIOD 4 Years —

CONDITIONS Operation of Generator

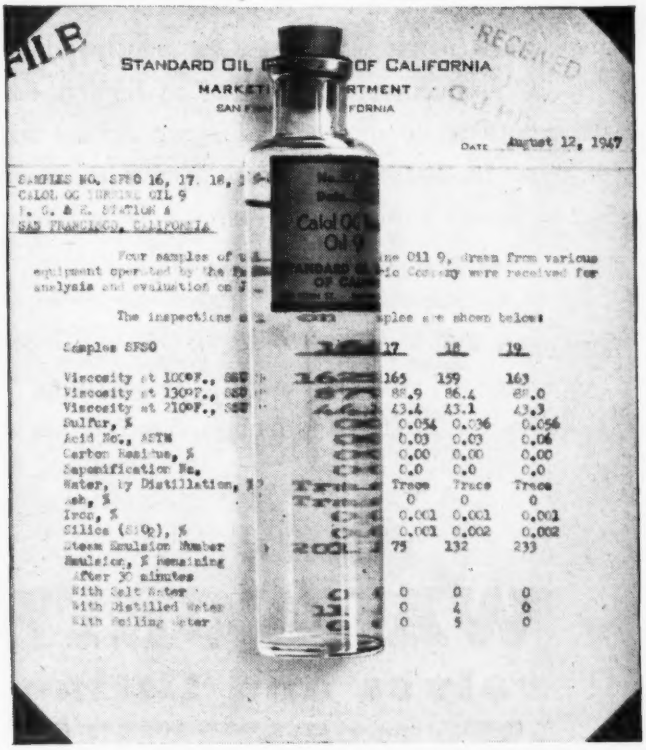
LOCATION San Francisco Station A

FIRM Pacific Gas & Electric Co.

SAME OIL CHARGE USED IN TURBINE FOUR YEARS SHOWS NO DETERIORATION



More than four years ago the lubrication system of this turbine-generator was charged with Calol OC Turbine Oil—9. After continuous operation on this same oil charge during all of that time, a laboratory analysis showed the oil had not increased in acidity or deteriorated. Inspection of lines, sumps, and governor control mechanism showed them to be clean and free of sludge and lacquer. Journals remained in good condition. Calol OC Turbine Oil resists both oxidation and corrosion.



FILE

STANDARD OIL [illegible] OF CALIFORNIA

MARKET[illegible] RTMENT

SAN [illegible] FORNIA

RECEIVED

DATE August 12, 1947

SAMPLES NO. SFSO 16, 17, 18, [illegible]

CALOL OC TURBINE OIL 9

P. G. & E. STATION A

SAN FRANCISCO, CALIFORNIA

Four samples of [illegible] ne Oil 9, drawn from various equipment operated by the P[illegible] ric Company were received for analysis and evaluation on J[illegible]

The inspections o[illegible] mples are shown below:

Samples SFSO	[illegible]	17	18	19
Viscosity at 100°F., SSU	[illegible]	165	159	163
Viscosity at 130°F., SSU	[illegible]	88.9	86.4	88.0
Viscosity at 210°F., SSU	[illegible]	43.4	43.1	43.3
Sulfur, %	[illegible]	0.054	0.036	0.056
Acid No., ASTM	[illegible]	0.03	0.03	0.06
Carbon Residue, %	[illegible]	0.00	0.00	0.00
Saponification No.	[illegible]	0.0	0.0	0.0
Water, by Distillation, %	[illegible]	Trace	Trace	Trace
Ash, %	[illegible]	0	0	0
Iron, %	[illegible]	0.001	0.001	0.002
Silica (SiO_2), %	[illegible]	0.001	0.002	0.002
Steam Emulsion Number	[illegible]	75	132	233
Emulsion, % remaining after 30 minutes				
With Salt Water	[illegible]	0	0	0
With Distilled Water	[illegible]	0	4	0
With Boiling Water	[illegible]	0	5	0

Note how clear this sample of the Calol OC Turbine Oil charge remained after 4 years of use - figures can be read through it and there is no deposit at the bottom of the bottle. The actual specifications of the used oil from the turbine-generator is one of the four sets shown here.

REMARKS: Calol OC Turbine Oil is specially compounded to provide long service and give full protection to all vital bearing surfaces. It contains a highly effective oxidation inhibitor which resists the action of air, heat and moisture, preventing sludging and lacquer formation, reducing oil maintenance costs to a minimum. Its corrosion inhibitor and excellent metal-wetting ability stop rusting, even in initial operation of turbines. Calol OC Turbine Oil is made in five grades to meet various installation conditions.

STANDARD TECHNICAL SERVICE conducted and reported this test: If you have a lubrication or fuel problem, your Standard Fuel and Lubricant Engineer or Representative will give you expert help; or write Standard of California, 225 Bush Street, San Francisco 20.

STANDARD OF CALIFORNIA • San Francisco, Calif. STANDARD OIL COMPANY OF TEXAS • El Paso, Texas
THE CALIFORNIA COMPANY • Denver, Colo. THE CALIFORNIA OIL COMPANY • New York

FOR ALL MAJOR SERVICES
IN PRINCIPAL INDUSTRIES

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assure low cost dependable performance

Walworth manufactures a **complete line** of valves and pipe fittings for ALL major services in principal industries. All Walworth products are made to the highest standards of quality, both as to dimensional accuracy and metallurgical properties. In design, construction, and performance, they reflect Walworth's 105 years of "know how" in the manufacture of quality valves and fittings.

Your Walworth distributor will give you full information on the **complete line** of Walworth steel, iron, and bronze valves, and pipe fittings; also Walworth Lubricated Plug Valves, and Walseal* valves, fittings and flanges. Ask for this information today.

*Patented–Reg. U. S. Pat. Off.

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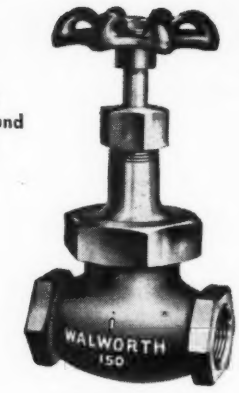
60 EAST 42nd STREET, NEW YORK 17, N. Y.

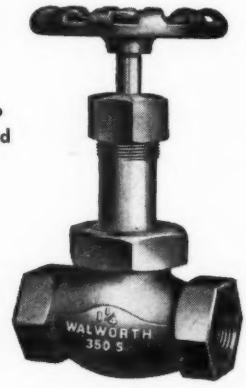
DISTRIBUTORS IN PRINCIPAL CENTERS
THROUGHOUT THE WORLD

No. 95
150-Pound
Bronze
Valve



Renewable Disc

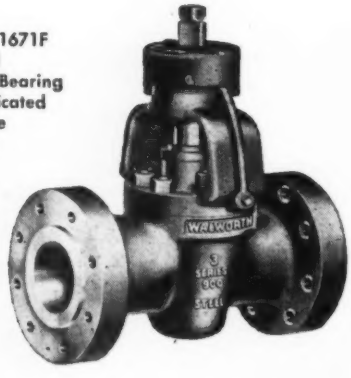
No. 225P
350-Pound
Bronze
Valve



"500 Brinell" Seat & Disc

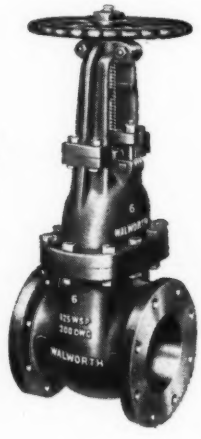
No. 709
Iron Body
Saddle
Gate
Valve

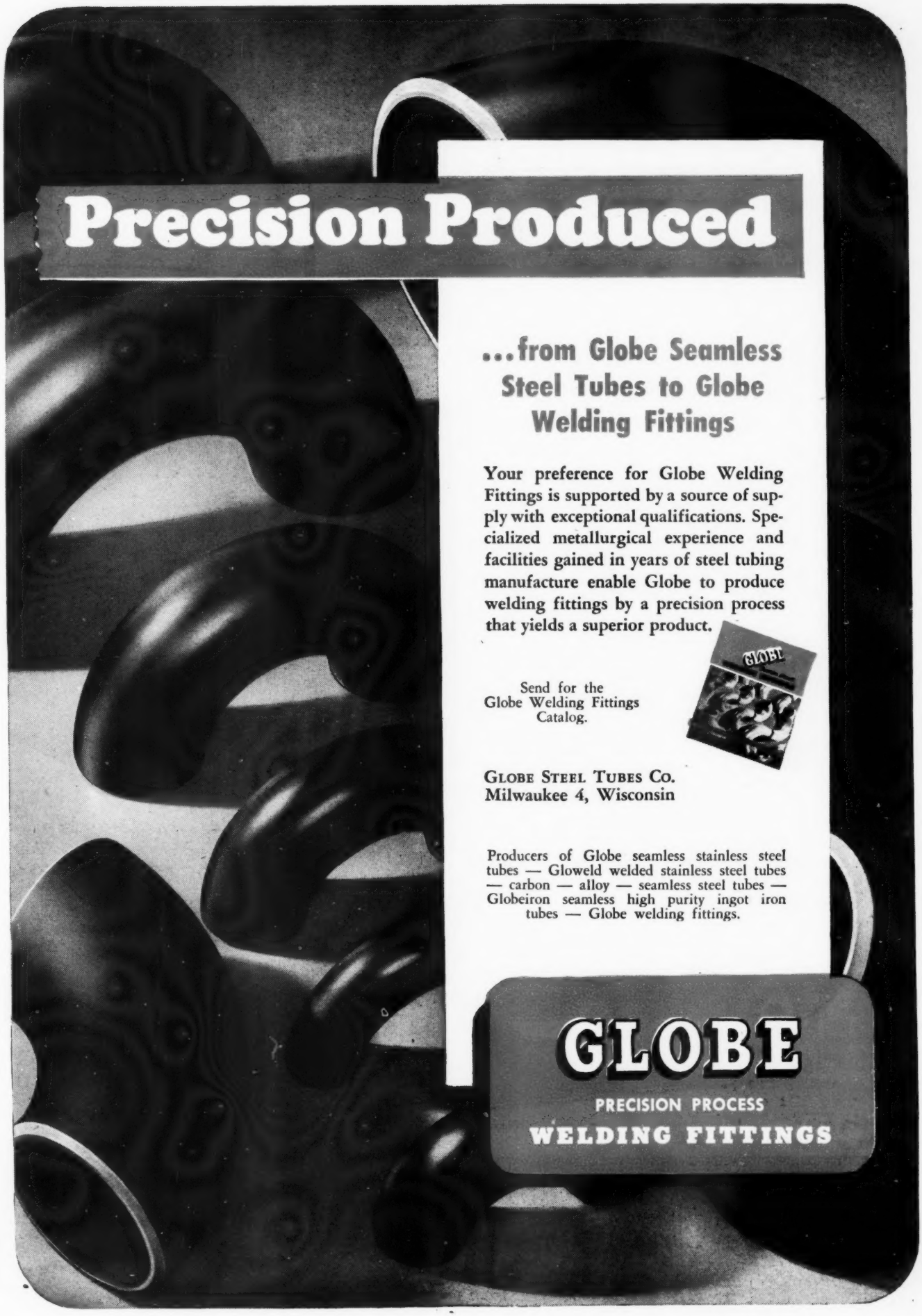
No. 1671F
Steel
Ball Bearing
Lubricated
Valve
Plug



Pressure-
Seal
Steel
Valve

No. 726F
Iron Body
Wedge
Gate
Valve





Precision Produced

...from Globe Seamless Steel Tubes to Globe Welding Fittings

Your preference for Globe Welding Fittings is supported by a source of supply with exceptional qualifications. Specialized metallurgical experience and facilities gained in years of steel tubing manufacture enable Globe to produce welding fittings by a precision process that yields a superior product.

Send for the
Globe Welding Fittings
Catalog.

GLOBE STEEL TUBES CO.
Milwaukee 4, Wisconsin

Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — carbon — alloy — seamless steel tubes — Globeiron seamless high purity ingot iron tubes — Globe welding fittings.

GLOBE
PRECISION PROCESS
WELDING FITTINGS

When you buy a SUPERIOR Steam Generator

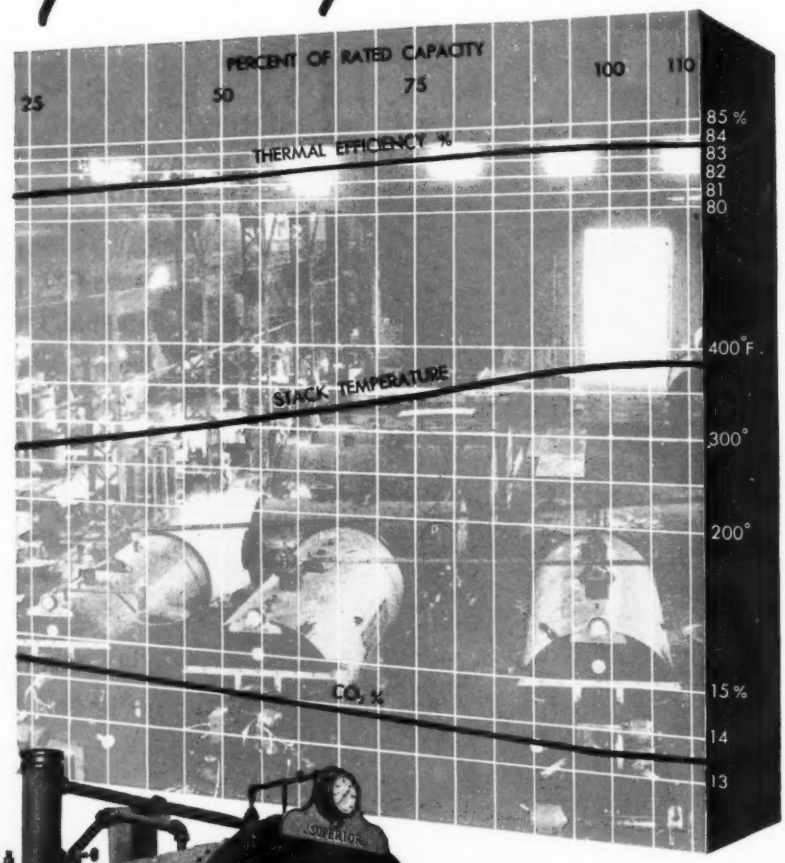
You Buy Results!

Superior Steam Generators are better designed, better made . . . results prove it.

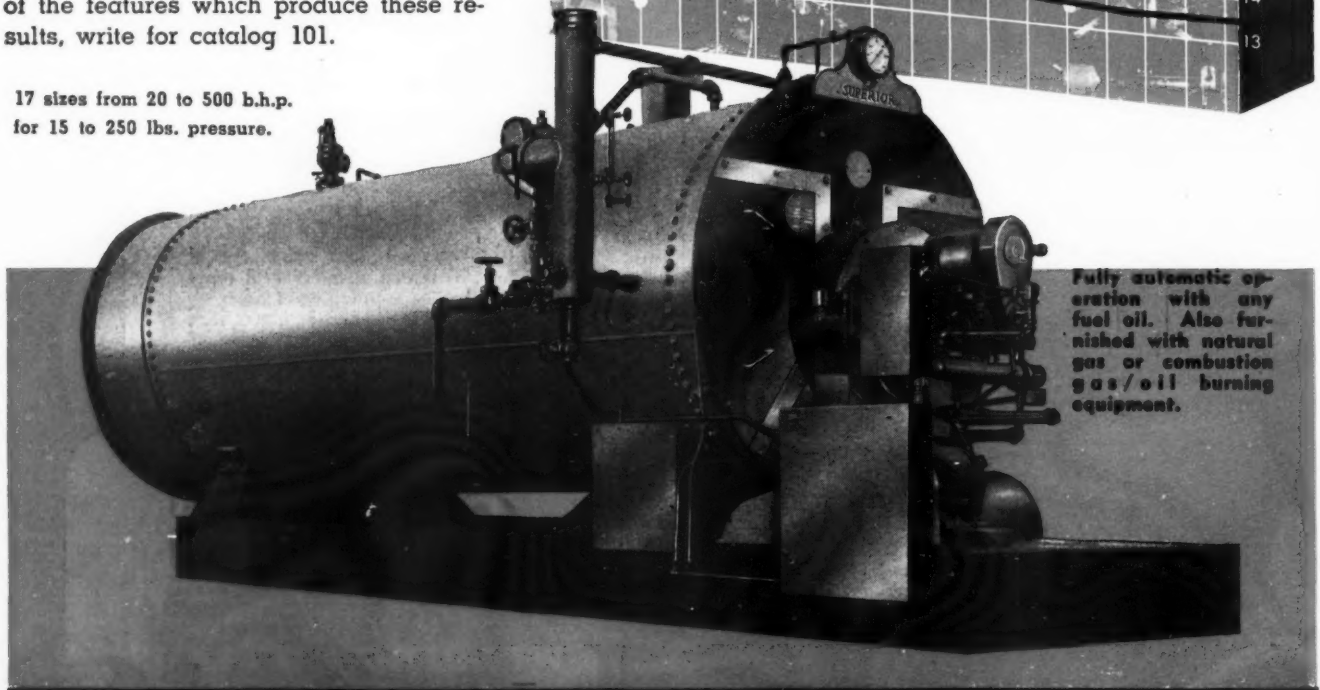
The accompanying graph tabulates the actual data recorded during recent tests performed on a Superior Steam Generator which has been in operation a full year. Professors Jackson and Holme of Lehigh University made the tests and recorded the data from instruments supplied by their university.

Note the high efficiencies developed over a firing range which varies from 25% to 110% of rated capacity . . . and these tabulations take *everything* into account . . . even the small water content of the steam was deducted from the thermal efficiency.

These high efficiencies spell savings in fuel and operating costs. For details of the features which produce these results, write for catalog 101.



17 sizes from 20 to 500 b.h.p. for 15 to 250 lbs. pressure.



Fully automatic operation with any fuel oil. Also furnished with natural gas or combustion gas/oil burning equipment.

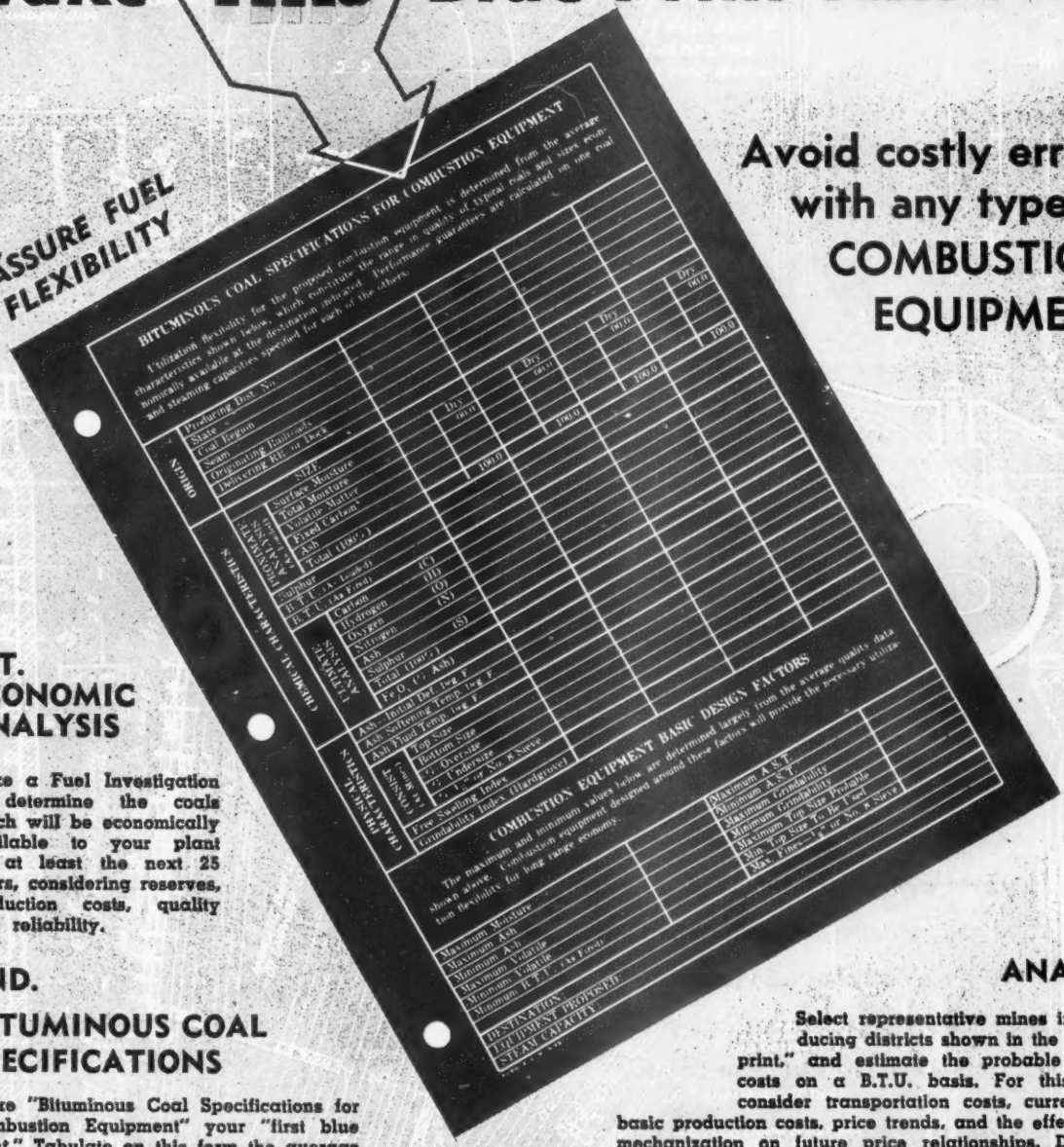
Superior Combustion Industries, inc.

Factory Emmaus, Pa.

Executive Offices Times Building, Times Square, New York 18, N. Y.

Make THIS Blue Print FIRST

ASSURE FUEL FLEXIBILITY



Avoid costly errors with any type of COMBUSTION EQUIPMENT

1ST. ECONOMIC ANALYSIS

Make a Fuel Investigation to determine the coals which will be economically available to your plant for at least the next 25 years, considering reserves, production costs, quality and reliability.

2ND. BITUMINOUS COAL SPECIFICATIONS

Make "Bituminous Coal Specifications for Combustion Equipment" your "first blue print." Tabulate on this form the average quality, characteristics and sizes of at least four coals from different producing districts. These coals should constitute the range of coals to be used for generating low cost steam during the life of the plant.

From these average data establish the Combustion Equipment Design Factors, using sufficient tolerances to cover normal variations in quality. It is a costly error to purchase new equipment which is inadequate to burn the range of coals economically available.

3RD. COAL ANALYSIS

Select representative mines in the producing districts shown in the "first blue print," and estimate the probable delivered costs on a B.T.U. basis. For this purpose consider transportation costs, current prices, basic production costs, price trends, and the effect of mine mechanization on future price relationships. Design the plant to use efficiently the coals that have the best competitive future.

FAIRMONT LOW FUSION COAL MEETS EVERY REQUIREMENT FOR LOW COST STEAM GENERATION

. . . it can be burned economically in any equipment properly engineered for its use . . . huge reserves extend the availability of this coal into the far distant future . . . it usually represents "the best value for the fuel dollar" for long range planning. . . . engineering to use FAIRMONT COAL assures the lowest overall steam cost for the life of the plant.

MAIL COUPON

FAIRMONT COAL BUREAU, Chanin Bldg., 122 E. 42nd St., New York 17, N.Y.

1. Return this coupon for a copy of the form "Bituminous Coal Specifications for Combustion Equipment."
2. Place my name on the mailing list for Fairmont Coal Bureau Reference Bulletins. 1. ☐ 2. ☐ (Indicate desires by checking squares.)

NAME..... POSITION.....

COMPANY.....

STREET ADDRESS..... CITY..... Zone..... State.....

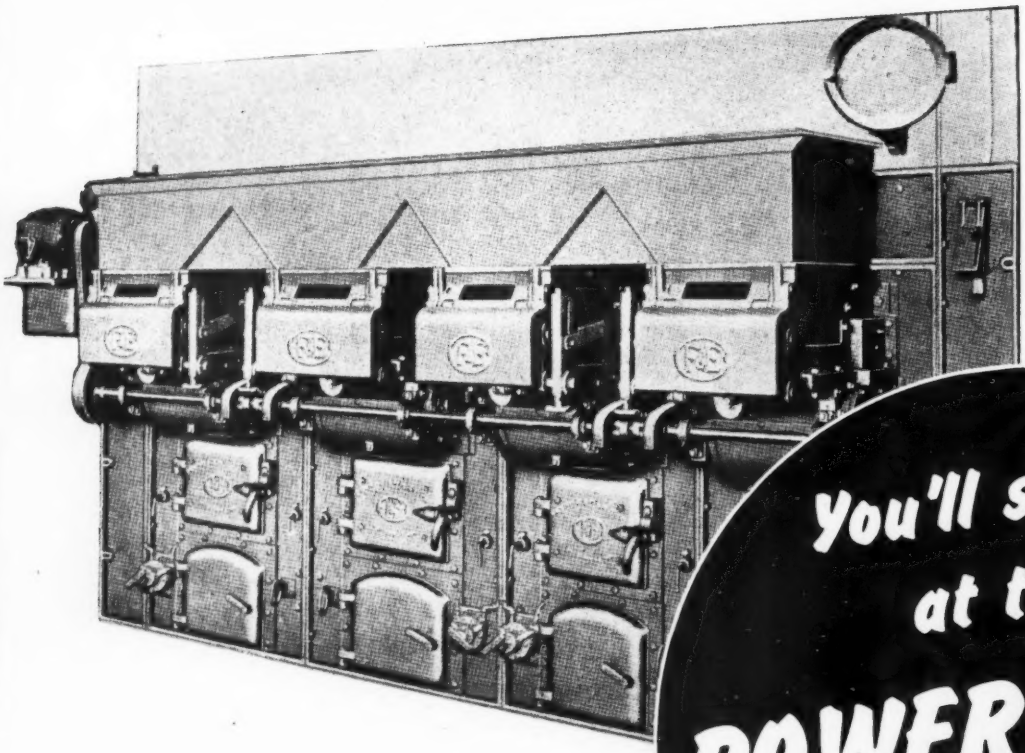
P-12-48

FAIRMONT COAL BUREAU · FAIRMONT REGION · WEST VIRGINIA · SERVICE TO INDUSTRY ·

A *new* SPREADER STOKER

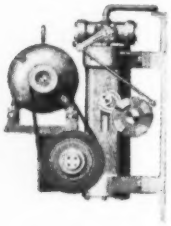
BY

F&E



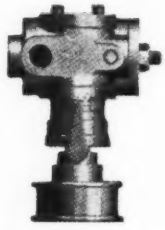
You'll see it at the POWER SHOW Nov. 29 - Dec. 4 Booth 18

The Flynn and Emrich Company welcomes the opportunity to show you the "F & E" Spreader Stoker with electro-hydraulic drive. Embodying many new features and improvements, this stoker will speak for itself as you will see when you visit us at the Power Show.



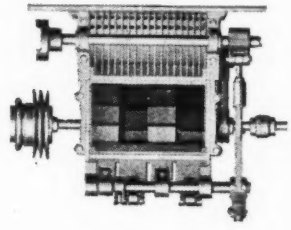
ELECTRO-HYDRAULIC DRIVE

Supplies hydraulic power for operating coal feed pushers.



INCREMENTAL HYDRAULIC CONTROL VALVE

Controls the coal feed by regulating the oil supply to the hydraulic cylinder.



ALTERNATE COAL FEED PUSHERS

Sectional in design, alternate movement, insures dependable continuous feed.

F&E

FLYNN & EMRICH COMPANY

HOLLIDAY & SARATOGA STS. ESTABLISHED 1842 BALTIMORE 2, MARYLAND

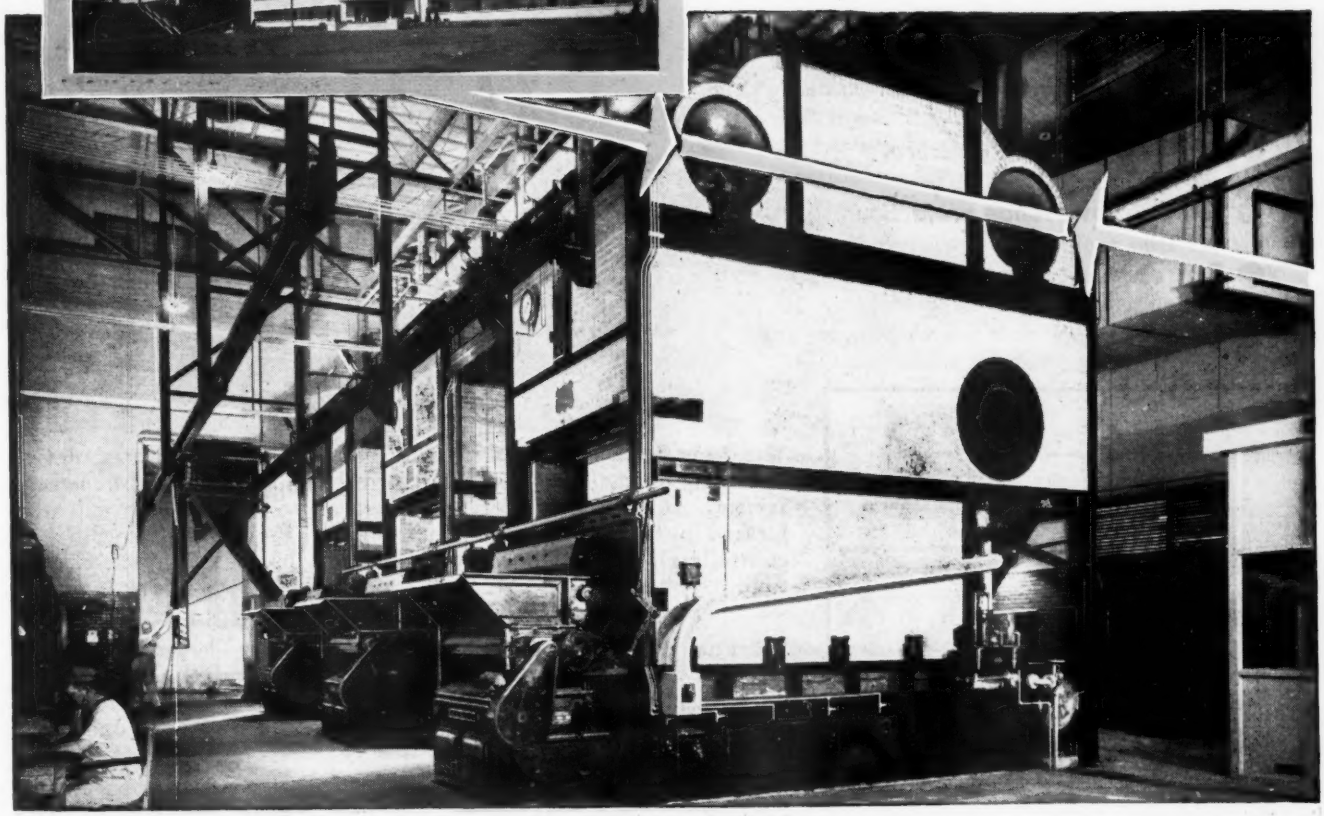
UNION "L" TYPE BOILER

Features 2 TOP DRUMS ON SAME LEVEL

TYPE "L", the low headroom 3-drum boiler, one of the 13 basic types of Union Boilers features large steam releasing surface. The two top drums located on the same center line without complete submergence of either drum are equally steam and water drums.

This principle of drum placement permits a compact design with an unusually steep front tube bank. The slope of the front tube bank is 3" per foot. The combination of these features assures rapid circulation as well as a large steam disengaging surface.

The Union "L" Boiler is adaptable to stoker, pulverized coal, and oil firing. *Write for Bulletin "L" for complete data on this low headroom boiler.*



3 UNION Type "L" Low Headroom. 3-drum boilers installed in the modern plant of The Emerson Electric Manufacturing Co., at St. Louis, Mo. Plant was designed and built by The Austin Company, Cleveland, Ohio.

UNION IRON WORKS - - - *Since 1890*

1281 Cascade Street • Erie, Penna.

BOILERS — PROCESS EQUIPMENT — FABRICATED STEEL

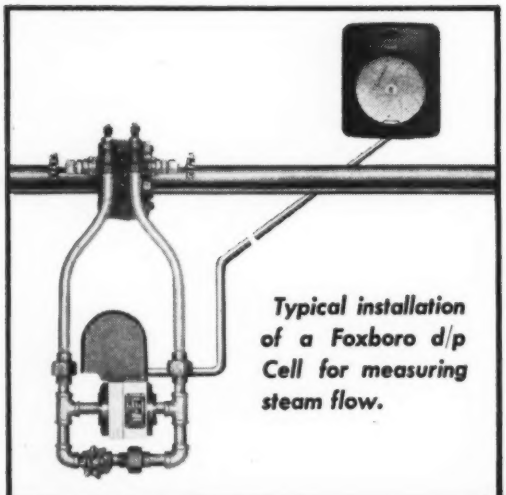
NEW!

Revolutionary

DIFFERENTIAL PRESSURE CELL

SIMPLIFIES MEASUREMENT OF STEAM FLOW

- *Positive, direct, force-balance operation.*
- *Zero displacement.*
- *No mercury used.*
- *All parts exposed to measured fluid are of Type 316 Stainless construction.*
- *1500 lb. operating pressure.*
- *Absolute overrange protection.*
- *Easy range change.*
- *Weatherproof.*



Typical installation of a Foxboro d/p Cell for measuring steam flow.

The new Foxboro d/p Cell is a flexible, easily-calibrated device operating on the highly accurate force-balance principle. *No mercury is used.* It transmits flow measurement to remote, conveniently-located pneumatic receiving instruments (indicating, recording, or controlling). It is small, weighs less than 20 lbs. . . .simple in construction. Absolute built-in overrange protection on both sides.

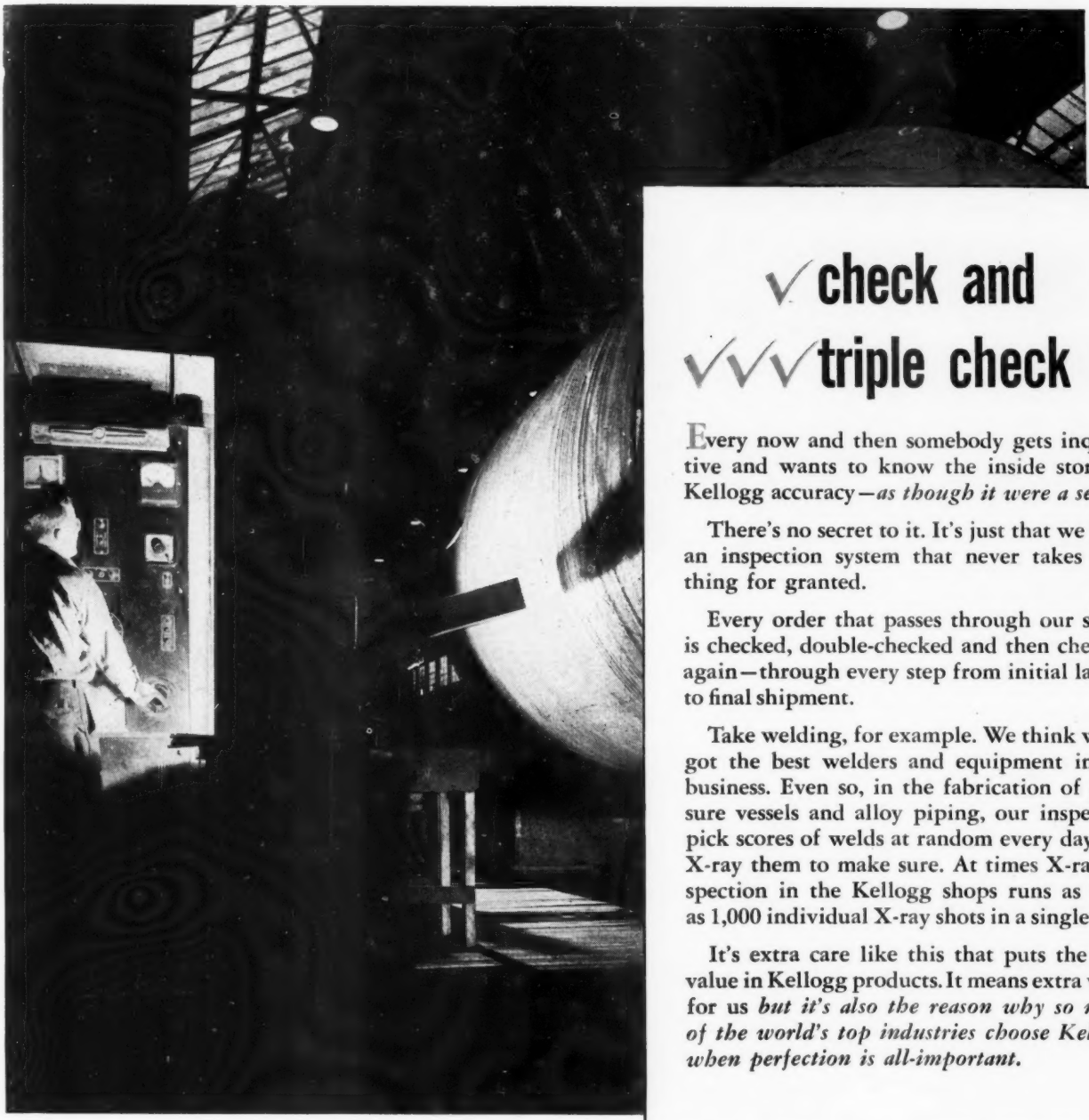
NO CONDENSING CHAMBERS NEEDED

Essentially zero displacement of the measuring element eliminates the need for condensing chambers. Because of its compact size, the d/p Cell can be installed close to the steam line . . . and the entire installation insulated where there is danger of lead line condensate freezing.

Learn all about this new, unique development. It may be the ideal solution to your measurement problem. Write for Bulletin 420. **The Foxboro Company, 68 Neponset Ave., Foxboro, Mass., U. S. A.**

FOXBORO
REG. U. S. PAT. OFF.

RECORDING · CONTROLLING · INDICATING
INSTRUMENTS



✓ check and ✓✓✓ triple check

Every now and then somebody gets inquisitive and wants to know the inside story of Kellogg accuracy—*as though it were a secret.*

There's no secret to it. It's just that we have an inspection system that never takes anything for granted.

Every order that passes through our shops is checked, double-checked and then checked again—through every step from initial layout to final shipment.

Take welding, for example. We think we've got the best welders and equipment in the business. Even so, in the fabrication of pressure vessels and alloy piping, our inspectors pick scores of welds at random every day and X-ray them to make sure. At times X-ray inspection in the Kellogg shops runs as high as 1,000 individual X-ray shots in a single day!

It's extra care like this that puts the plus value in Kellogg products. It means extra work for us *but it's also the reason why so many of the world's top industries choose Kellogg when perfection is all-important.*

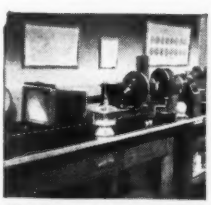
FABRICATED PRODUCTS DIVISION

THE M. W. KELLOGG COMPANY

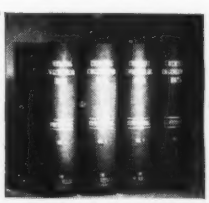
A SUBSIDIARY OF PULLMAN INC.

NEW YORK • JERSEY CITY • BUFFALO • LOS ANGELES
TULSA • HOUSTON • TORONTO • LONDON • PARIS

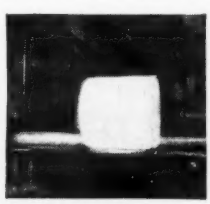
VESSELS • EXCHANGERS • CONDENSERS • HIGH PRESSURE AND HIGH TEMPERATURE POWER PIPING PROCESS PIPING • FORGED AND WELDED FITTINGS . . . IN ALL STEELS, ALLOYS OR SPECIAL COMBINATIONS



Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.



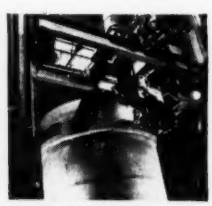
Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.



Complete Facilities for the fabrication of steel products from simple forgings to the most intricate 120 foot towers.

Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

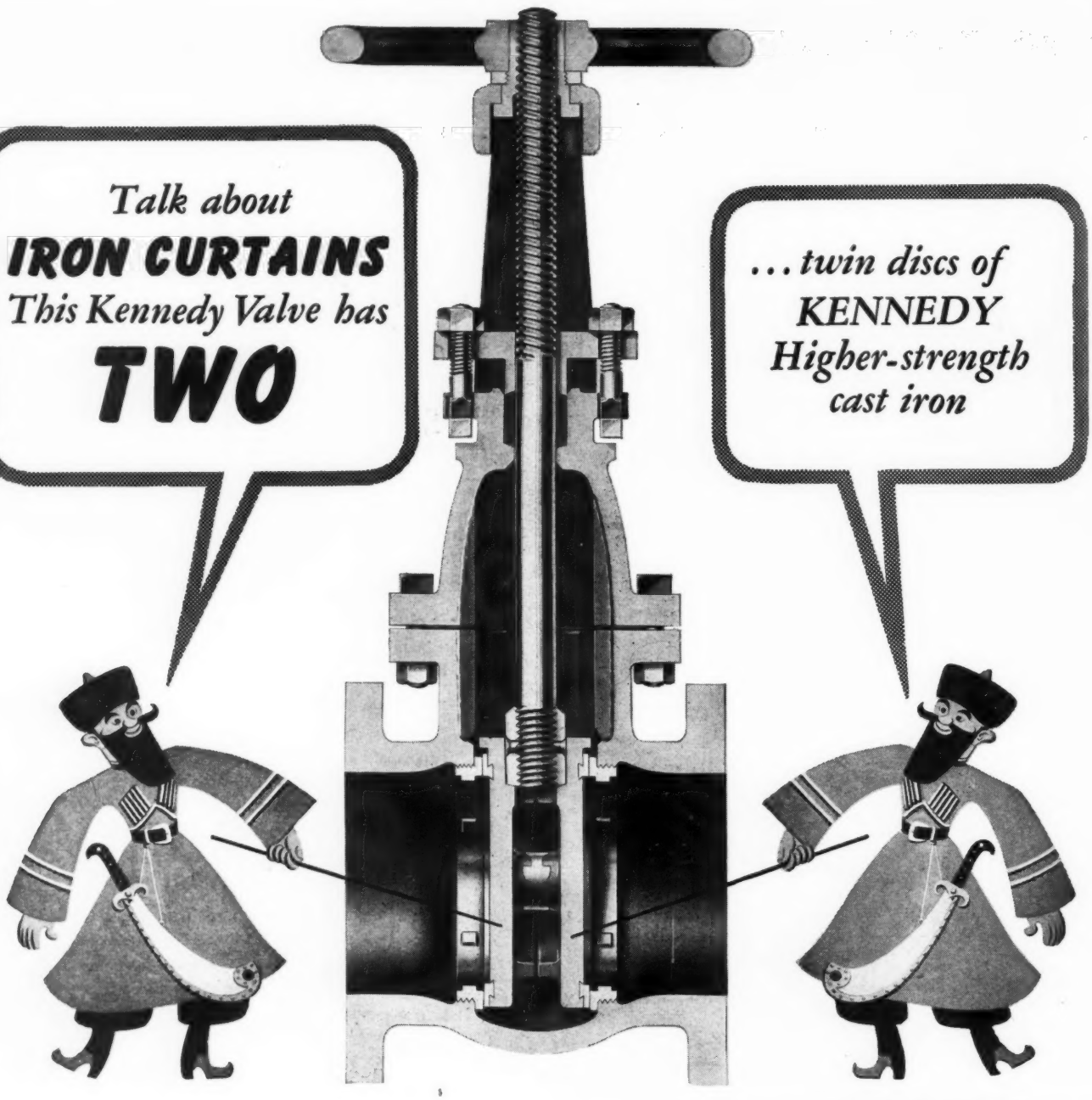
On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.



Top Welding Performance assured by specially designed equipment and exclusive employment of master operators.

Talk about
IRON CURTAINS
This Kennedy Valve has
TWO

... twin discs of
KENNEDY
Higher-strength
cast iron

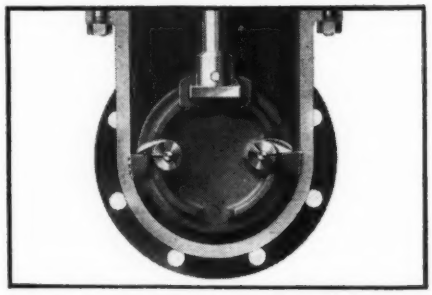


When you close a Kennedy Iron-Body Double-Disc Gate Valve, you drop a *double* iron curtain...twin discs of Kennedy Higher-strength Cast Iron – double assurance of complete closure, even when grit is present in the liquid being handled. As soon as the port opening is completely closed, a wedging device between the discs drives them apart . . . forcing each disc against its seat. If grit is caught on one seat, the other seats tightly.

The lodgment of sediment or the position of the valve will not affect the action of the cams and discs. Operation is perfect with either disc toward the pressure.

Every Kennedy valve...Iron-Body or Bronze...gate, globe, angle or check ...is designed with equal care to give reliable performance in its particular application.

BUY FROM YOUR LOCAL DISTRIBUTOR.

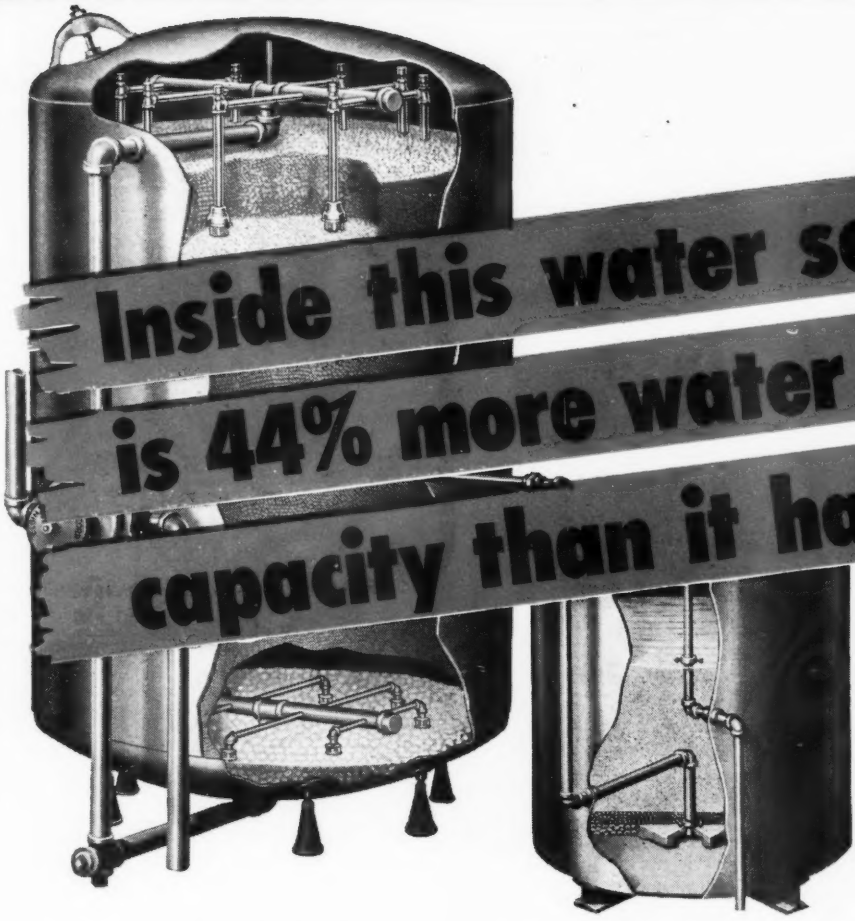


Kennedy Iron-Body Double-Disc Gate Valves are available with non-rising stem or outside-screw-and-yoke, for low, standard, medium or extra heavy pressures, in a full range of standard sizes. The Kennedy 240-page catalog contains full details.

KV-177

THE KENNEDY VALVE MFG. CO., ELMIRA, NEW YORK
Office and Warehouses in principal Cities

KENNEDY valves-pipe fittings-fire hydrants



Inside this water softener is 44% more water softening capacity than it had before

This is the inside story on how the capacity of a water softener was boosted 44%. Here was a 48" x 72" synthetic zeolite unit, operating on 10-grain water. Its capacity was 48,000 gallons. We equipped it with our ingenious "Double-Check" manifold system which permits a deeper bed of zeolite to be utilized efficiently. (Elgin's "Double-Check" manifold system can be installed in water softeners of any make.) Capacity was thereby increased to 69,000 gallons — representing a gain of 21,000 gallons, or 44% more water softening capacity than before.

This typical case illustrates the remarkable principle on which Elgin Zeolite Water Softeners are based. The "Double-Check" principle not only permits far more zeolite to be placed in a softener unit, but prevents the zeolite from being lost. It also permits a faster backwash rate which keeps the zeolite thoroughly clean and at peak performance. The result is up to 44% more softening capacity than is given by a conventional softener of equal size — more water softened by each cubic foot of zeolite — and less regenerating salt required.

We are happy to give present water softener users these Elgin advantages which cannot be secured from other manufacturers. But we are happier when we can make the installation all Elgin—with the advanced design that is characteristic of our entire line. Those we serve also gain much from Elgin's engineering of the job—an individualized service that draws on our 40 years' specialized experience in all phases of water conditioning.

Whatever your water conditioning problem, won't you give us the opportunity of showing you what the Elgin organization can do for you? The coupon below has been inserted for your convenience. It will bring prompt action from us without obligation to you.

Other Elgin Water Conditioning Products

1. Boiler feed water treatments
2. Corrosion prevention treatments for steam system
3. Corrosion prevention for hot and cold water lines
4. Deconcentrator systems
5. Filters and purifiers
6. Iron removal equipment
7. Aerators and Degasitors
8. Chemical feeders
9. Water testing equipment
10. Elgin Quality Zeolites—all types

Use coupon below for detailed information

ELGIN SOFTENER CORPORATION, 130 N. Grove Ave., Elgin, Illinois

ELGIN
ECONOMICAL
WATER CONDITIONING

Coupon brings facts

I am interested in:

☐ Elgin Water Softener. ☐ Modernizing our water softener.

Product No..... (See numbers above).

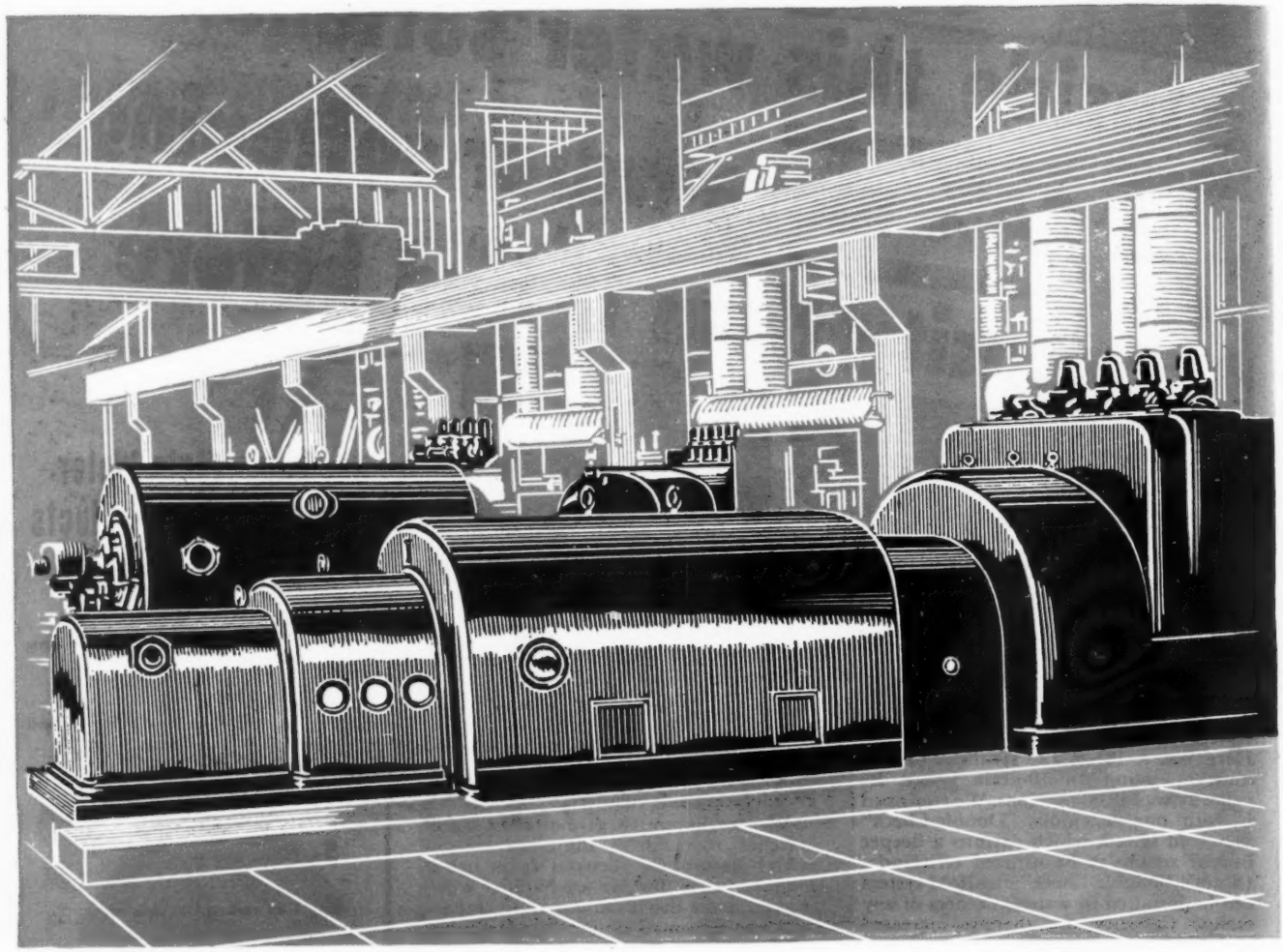
NAME_____

COMPANY_____

ADDRESS_____

Mail to—ELGIN SOFTENER CORPORATION 130 North Grove Avenue, Elgin, Illinois

YES! Tycol Aturbrio Turbine Oils perform better . . . BETTER . . . BETTER



Tycol Aturbrio Turbine Oils perform better because:

. . . *Tycol Aturbrio Oils* mean economical and more efficient lubrication plus positive protection against corrosion and rust.

. . . *Tycol Aturbrio Oils* are characterized by exceptionally good oxidation stability and demulsibility . . . they put an end to sludging troubles.

. . . *Tycol Aturbrio Oils* are justly famous for their dependability and endurance . . . have performed superbly in many plants for years without a change.

Complete and detailed information on Tycol Aturbrio Turbine Oils is available from your nearest Tide Water Associated Office. Call or write in today.

TYCOL
INDUSTRIAL LUBRICANTS

**Boston • Charlotte, N. C.
Pittsburgh • Philadelphia
Chicago • Detroit • Tulsa
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TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE · NEW YORK 4, N.Y.

LUBRICATION — "ENGINEERED TO FIT THE JOB"

Ready power for the PETROLEUM INDUSTRY with WICKES TYPE-A water tube boiler

Designed for efficient steam generation, Wickes Type-A water tube boilers are now in use in the nation's leading oil refineries. Three proved advantages make this Wickes unit *the most efficient of its type:* 1) — It has twice the black surface of the average boiler; 2) — Combustion gases travel through staggered rows of tubes, assuring high operating efficiency under varying load conditions; 3) — Two simple U-tubes with no excessive resistance, *insure positive water circulation* necessary to high heat absorption. • Wickes Type-A Water Tube Boilers are made in capacities to 200,000 lbs. steam per hour, with pressures up to 850 lbs. psi. Drums welded to A.S.M.E. standards. *Write for descriptive catalogue.*

THE WICKES BOILER CO.

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

SALES OFFICES: Atlanta • Boston • Charlotte, N. C. • Chicago • Cincinnati • Denver • Detroit • Houston Indianapolis • Kansas City • Los Angeles • Milwaukee • New York City • Pittsburgh • San Francisco San Jose • Seattle • St. Louis • Tulsa • Saginaw • Mexico City • Buenos Aires.

RECOGNIZED QUALITY SINCE 1854

THIS RIC-WIL *Copperclad* LINE GOES OVER THE TOP...

Foilclad Units for 62 ft. riser were connected on ground and hoisted into place.

TO IMPROVE STEAM SUPPLY

To meet operating demands for an adequate supply of process steam the engineers of Canada Packers, Ltd., Toronto, installed this new over-the-top steam line. Made up of 550 lineal feet of 8 inch pipe, it is designed to carry 80,000 pounds of steam per hour at 150 psi, 366°F.

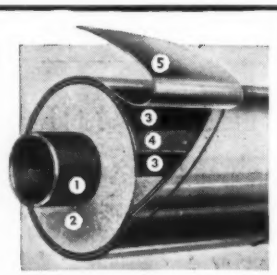
The line connects to a supply system running underground and rises vertically to form a huge expansion loop supported on the roof. Desired flexibility is obtained by shaping the structure to conform with roof contour and changes of roof elevation. The vertical pipe tangents absorb horizontal movement of the line due to expansion, while horizontal tangents perform a similar function with respect to vertical movement.

As specified, Ric-wiL pre-fabricated, pre-insulated Copperclad Piping was furnished in 21 foot tangents and elbow units, minimizing field erection costs. Ric-wiL sub-assemblies were scientifically designed to allow for pipe expansion and contraction, thus adding to the flexural properties of the system.

The Ric-wiL Copperclad Piping employed in this installation combines pipe, insulation, high temperature asphalt and spiral wrappings of asbestos felt and copper sheeting into thermally efficient units which are corrosion resistant and fully protected against the elements. This Ric-wiL construction is positive assurance of outstanding durability and long life with minimum upkeep and maintenance cost.

FOILCLAD CONSTRUCTION

1. Pipe as specified
2. Insulation
3. Double Coating of High-Temperature Asphalt
4. Asbestos Felt, Tension Wrapped
5. Copper or Aluminum Foil; Tension Wrapped



See Our Exhibit . . . Booth 827

HEATING & VENTILATING EXPO. — CHICAGO — JAN. 24-28

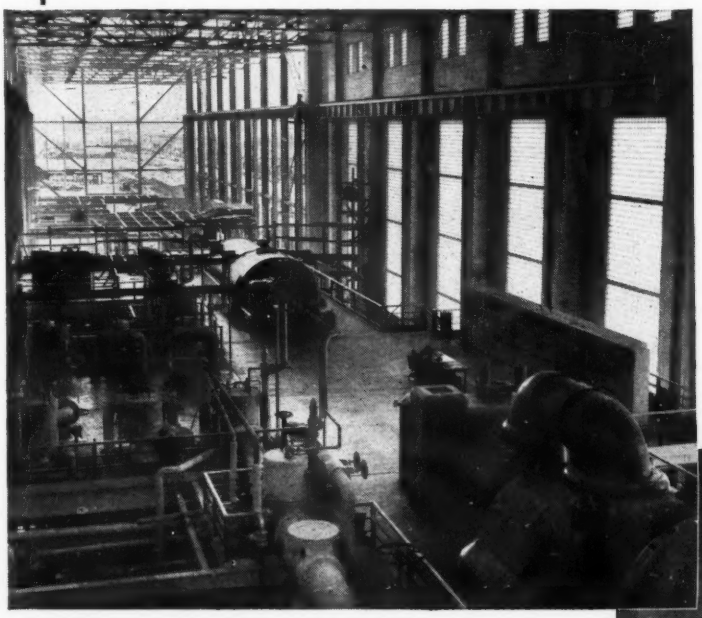
RIC-WIL

INSULATED PIPING SYSTEMS

THE RIC-WIL COMPANY • CLEVELAND, OHIO

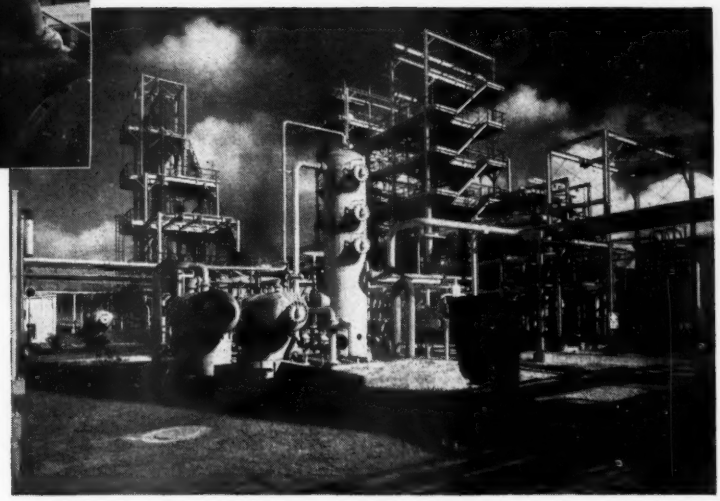
REPRESENTATIVES IN PRINCIPAL CITIES

THE Common denominator



Interior view of First Section of new Redondo Steam Station of Southern California Edison Company, now under construction at Redondo Beach, California.

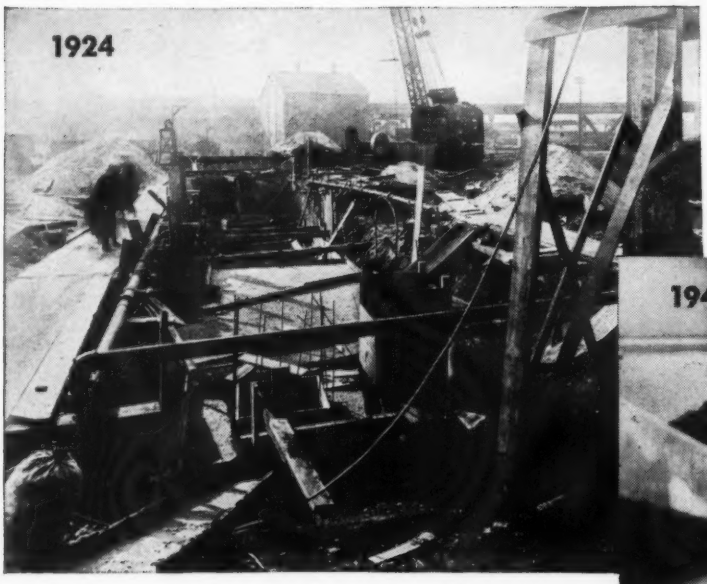
Crude Alcohol Unit of the Esso Standard Oil Company's Refinery at Baton Rouge, Louisiana.



Experience is the common denominator which is essential to the success of any project, large or small. The many years of experience of Stone & Webster Engineering Corporation in engineering, design and construction covers a wide range of diversified projects.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.



Underground power-line tunnel built in 1924. Wisconsin Steel Works, International Harvester Company, Chicago, Illinois.

Interior of tunnel today. Perfect protection continues.

24-Hour Strength in bitter cold weather

24-Year Service in power-line tunnel provided by

LUMNITE STRUCTURAL CONCRETE

It was 15 degrees below zero when workmen placed LUMNITE concrete in the forms for this underground power-line tunnel back in 1924. But despite the below-freezing temperature, LUMNITE gained *full-working strength* within 24 hours. Today it's in excellent condition and continues to give strong, durable service after 24 years!

Cold-weather concrete construction is facilitated by use of LUMNITE. Strong, durable concrete can be made in freezing weather, overnight, with a minimum of protection and without the use of artificial heat. LUMNITE, a calcium aluminate cement, generates its own heat to allow normal hardening. And its high 24-hour strength permits rapid maintenance jobs.

Besides its overnight structural advantages, LUMNITE'S adaptability and utility also serve modern power plants as Refractory, Heat- and Corrosion-resistant Concretes. LUMNITE linings for stacks, flues, coal bunkers and ash-pits provide smooth jointless surfaces, resulting in less resistance to flow of gases and less abrasive wear.

For further information, write to:

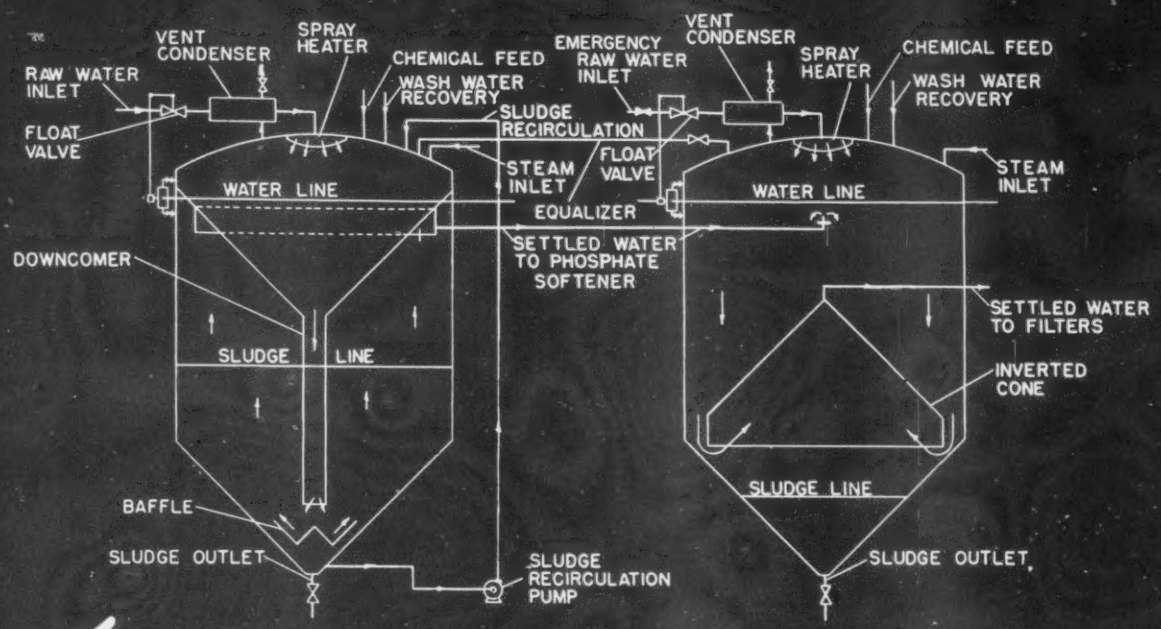
Lumnite Division

UNIVERSAL ATLAS CEMENT COMPANY

UNITED STATES STEEL CORPORATION SUBSIDIARY

135 EAST 42nd STREET • NEW YORK 17, N. Y.

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—ABC Network*



1/5th as much SILICA

IN BOILER FEED MAKE-UP

with the Permutit Sludge Blanket Hot Process!

A leading paper plant installed a Permutit Sludge Blanket Hot Process water softener. Silica was reduced to 1/5 the amount previously obtained with a conventional type softener. By feeding more magnesia, the silica content could be reduced to less than 1 ppm. The plant's estimated annual savings on treating chemicals exceeded $6,000.

Besides lowered chemical costs, the Permutit Hot Process brings you many *extra* advantages: More efficient use of magnesia! Lower turbidity in settling tank effluents! Longer filter runs! Greater adaptability to fluctuations in flow rates! Easier operation! This is another of Permutit's great achievements in the water conditioning field.

Permutit Products for Power Plants

Sludge Blanket Hot Lime Soda Softener (including silica removal)
Zeo-Karb: Hydrogen and Sodium Demineralization combined with Silica Removal • Silica Removal by Hot or Cold Precipitation Processes
Supplementary Chemical Feeding Equipment • Ranarex Mechanical CO_2 Indicators and Recorders
Continuous Blowoff Equipment
Deaerators and Open Heaters

CHARACTERISTICS	CONVENTIONAL DESIGN	SLUDGE BLANKET DESIGN
Silica in raw water, as SiO_2 ppm	55	55
Silica in effluent, as SiO_2 ppm	11	2.0
MgO feed, ppm	76	59
Parts SiO_2 removed per part MgO	0.6	1.1
Average retention time of $Mg(OH)_2$ in hours	4.7	100
Contact time of water with $Mg(OH)_2$ in minutes	92	87
Hardness of effluent, as $CaCO_3$ ppm	21	15
Average load on softener, % rated capacity	65	46
Temperature in softener	220° F	243° F

Write for full information to the Permutit Company, Dept. P-12, 330 West 42nd Street, New York 18, N. Y., or to the Permutit Company of Canada, Ltd., Montreal.

FOR 35 YEARS WATER CONDITIONING HEADQUARTERS

Permutit

BWH
BOSTON WOVEN HOSE & RUBBER COMPANY
DEPENDABLE RUGGEDNESS
This is the ROTOCURE Process of continuous vulcanization, exclusive with BWH. It does away with the 30 to 40-foot overlaps occurring in the duck carcass in old-fashioned flat-press curing, eliminates the possibility of operational weakness caused by such overcuring.
Cured Belt
Continuous Uniform Cure
Continuous Uniform Stretch

Exclusive BWH ROTOCURE Process of Continuous Vulcanization means continuous, trouble-free operation

Yes, all types of industry have discovered this fact . . . BWH ROTOCURE Belts do an outstanding job. And the record made by this Pennsylvania coal mine conveyor is a typical example of their performance. It's a veteran of many years' service through dark, dank tunnels. It has lugged giant, cumbersome cargoes at gratifying low per-ton costs. And it's still carrying on today.

One reason for such long, distinguished service is the special BWH process which inhibits mildew. But it's the exclusive BWH ROTOCURE Process of continuous vulcanization which accounts for the extraordinary stamina not only of this belt, but of all BWH belts.

What is ROTOCURE? It's a process developed by BWH technologists to produce conveyor belts that are 4-ways better, because:

1. ROTOCURE eliminates the press overlaps which occur in the duck carcass every 30 to 40 feet in belts made in flat press. Scientific tests prove such overlaps may reduce flex life as much as 40%.
2. ROTOCURE eliminates mechanical distortion, often occurring at press ends in flat-press curing.
3. ROTOCURE eliminates uneven stretch, because this method maintains constant, uniform stretch control throughout the curing process.
4. ROTOCURE eliminates overcure caused by press overlaps in rubber covers of conveyor belts and makes the covers uniformly abrasion resistant.

☆ ☆ ☆

HAVE YOU A JOB WHERE STAMINA COUNTS?
Bring us your toughest problems. We're specialists in solving them. Consult your nearest BWH distributor or write to us direct.

Another Quality Product of

BOSTON WOVEN HOSE & RUBBER COMPANY

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The Cities Service Heat Prover Cuts Operating Costs... Steps up Efficiency by Scientific Control of Combustion

IN ONE QUICK EXAMINATION the Cities Service Heat Prover can tell you how much efficiency you obtain from the fuel you burn. This remarkable instrument developed in the research laboratories of Cities Service accurately measures how much fuel is wasted unburned... how much is wasted in uselessly heating excess air.

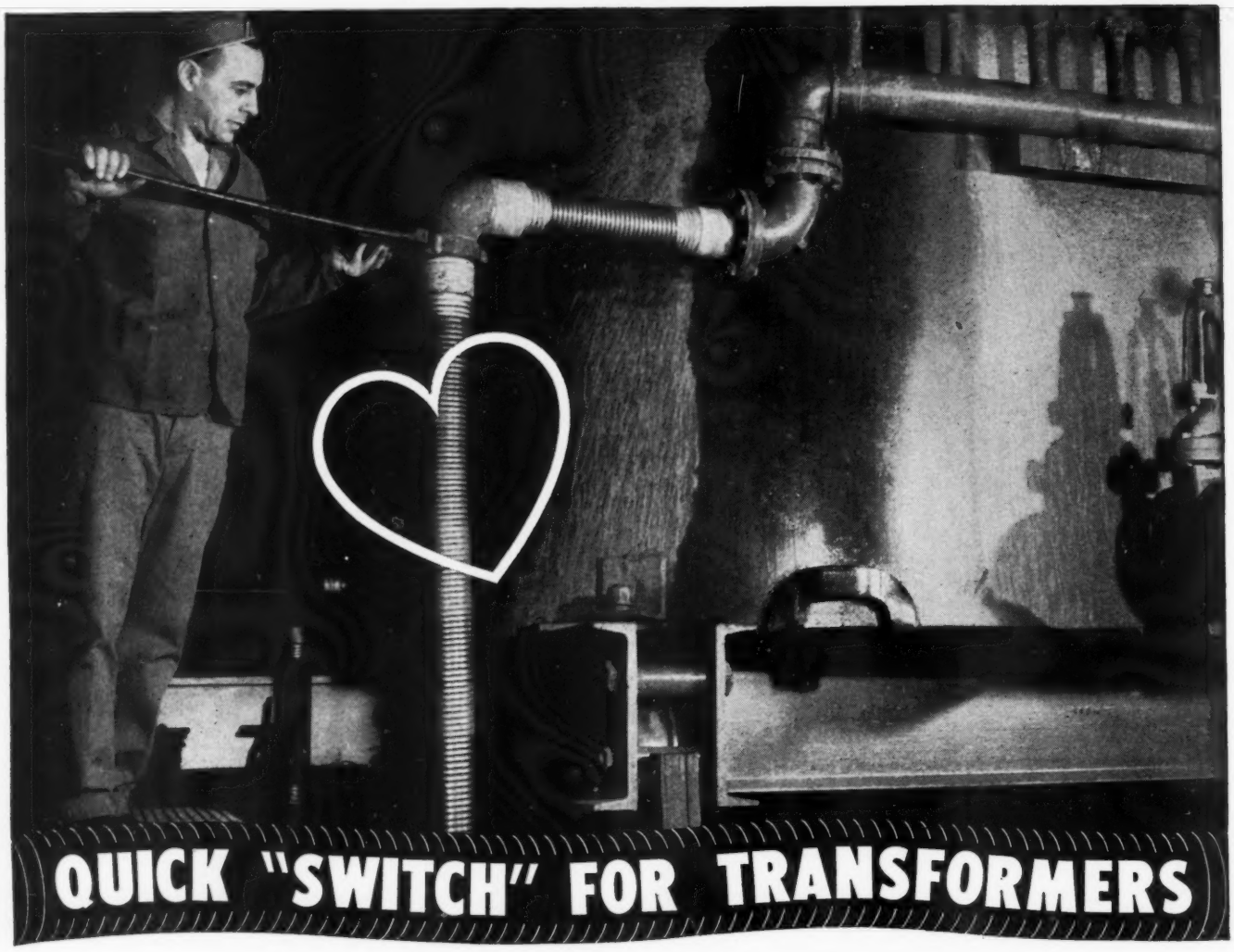
The instrument has been developed for use on industrial furnaces of every design regardless of the type of fuel used. It is also valuable when used for diesel and gasolene engine exhaust analysis.

There is no charge, no obligation; and no commitments made by you for this service. Write today for a demonstration.

FREE—A fact-filled booklet entitled "Combustion Control for Industry." Write Cities Service Oil Company, Sixty Wall Tower, Room 279 New York 5, New York.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS



QUICK "SWITCH" FOR TRANSFORMERS

Penflex metal hose cuts replacement time ⅓
... reduces costs ... speeds power resumption

Replacing faulty 220,000-volt transformers in a mammoth hydro-electric power station became a lengthy, troublesome task for one Eastern utilities company. When one of these 12 giants needs repairs, a spare has to be put in its place and quickly connected to cooling water pipes before resumption of service.

But since no two transformers are precisely alike, it was difficult to line up pipe flanges for bolting. Often special "wedges" had to be machined and inserted to obtain tight sealing . . . pipes had to be heated and bent . . . power output was delayed.

Troubles soon disappeared when Penflex engineers recommended 4" bronze interlocked flexible metal hose assemblies. Now, transformers are switched in almost ⅓ less time. Connections are quickly made because flexibility of hose allows for misalignment. Special machining and bending operations are eliminated . . . power is speedily resumed . . . man-hours reduced.

Penflex "Flexineering" (the science of engineering each type of flexible tubing to the problem) can help you iron out production wrinkles easily, economically. It will pay to know more about Penflex tubing layout service, streamlined for quick solution to your problems on flexible transmission of liquids, air, gases, or light solids. For complete service on flexible hose, tubing and couplings from ⅛" I. D. to 30" I. D., write today to . . .

PENNSYLVANIA FLEXIBLE METALLIC TUBING COMPANY

7238 Powers Lane — **Philadelphia 42, Pa.**

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Penflex... HEART OF INDUSTRY'S LIFE LINES

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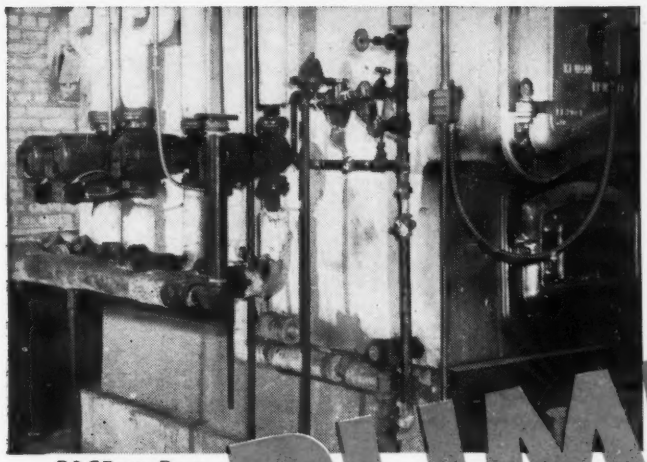
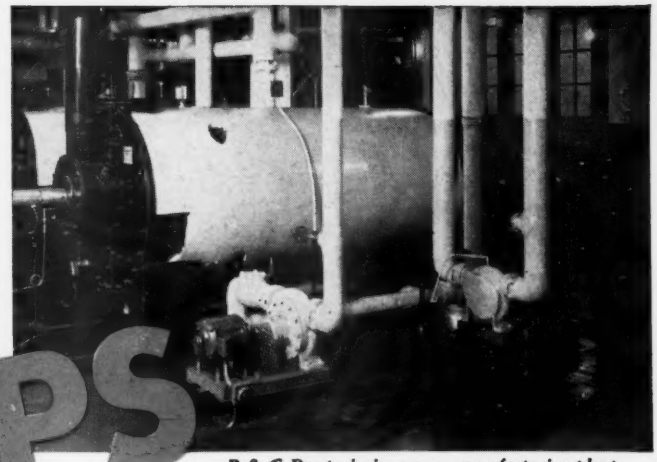


B&G Booster Pumps on zoned forced hot water heating system in industrial plant.



B & G Pumps in ice cream manufacturing plant.

PUMPS

FOR HEATING SYSTEMS AND INDUSTRIAL USE

...by the makers of Hydro-Flo PRODUCTS

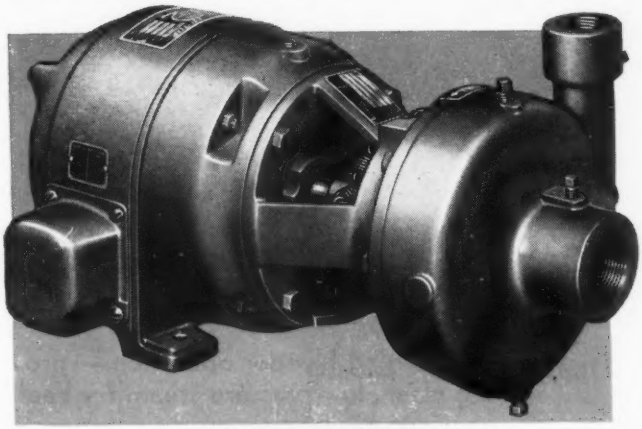
You can sum up the reasons for the universal acceptance of B & G Pumps in a single sentence—"Sound engineering, backed by modern manufacturing methods capable of translating good design into fine product."

When you specify "B & G" you can be sure that full value will be delivered, both in long service life and in low cost operation.

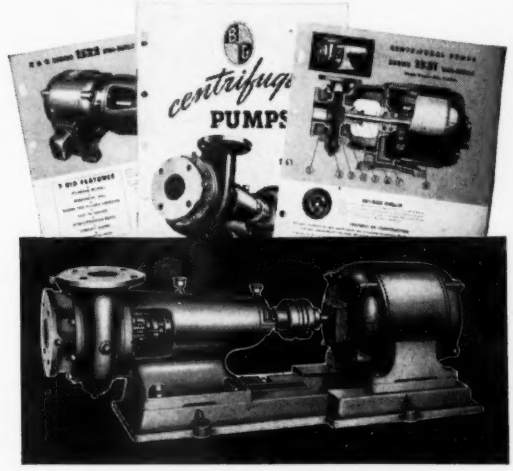
For example, you have only to watch a B & G Series 1522 Pump circulating a thick mixture of oil and metal chips to realize that it is a unit which can really handle difficult pumping jobs. Its outstanding features include—a Mechanical Seal instead of a stuffing box—Standard Motors—Spring-type Flexible Coupling—Interchangeable Parts—Compact Design—Easy Servicing.

All other models of B & G Centrifugal Pumps are likewise known for design features and precision workmanship which satisfy the most critical engineers and operating men.

Send for descriptive literature.



B & G Series 1522 Pump



B & G Series 1510-1515 Pump

Base-mounted, flexible coupled units with semi-open or enclosed impellers. Accurate machining and mechanical balancing assure quiet operation and peak efficiency.

B & G Booster

B & G Boosters have a nationwide reputation for completely dependable operation in forced hot water heating systems. Over a half million Boosters have been installed to date in buildings of every size and character.

B&G *Hydro-Flo* Products also include Heat Exchangers . . . Refrigeration Components . . . Oil Coolers . . . Water Heaters . . . and Forced Hot Water Heating Equipment. Write for literature—you'll find it profitable to get full information on this well-known, fast-selling line.

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BELL & GOSSETT CO. • Dept. AU-36, Morton Grove, Illinois

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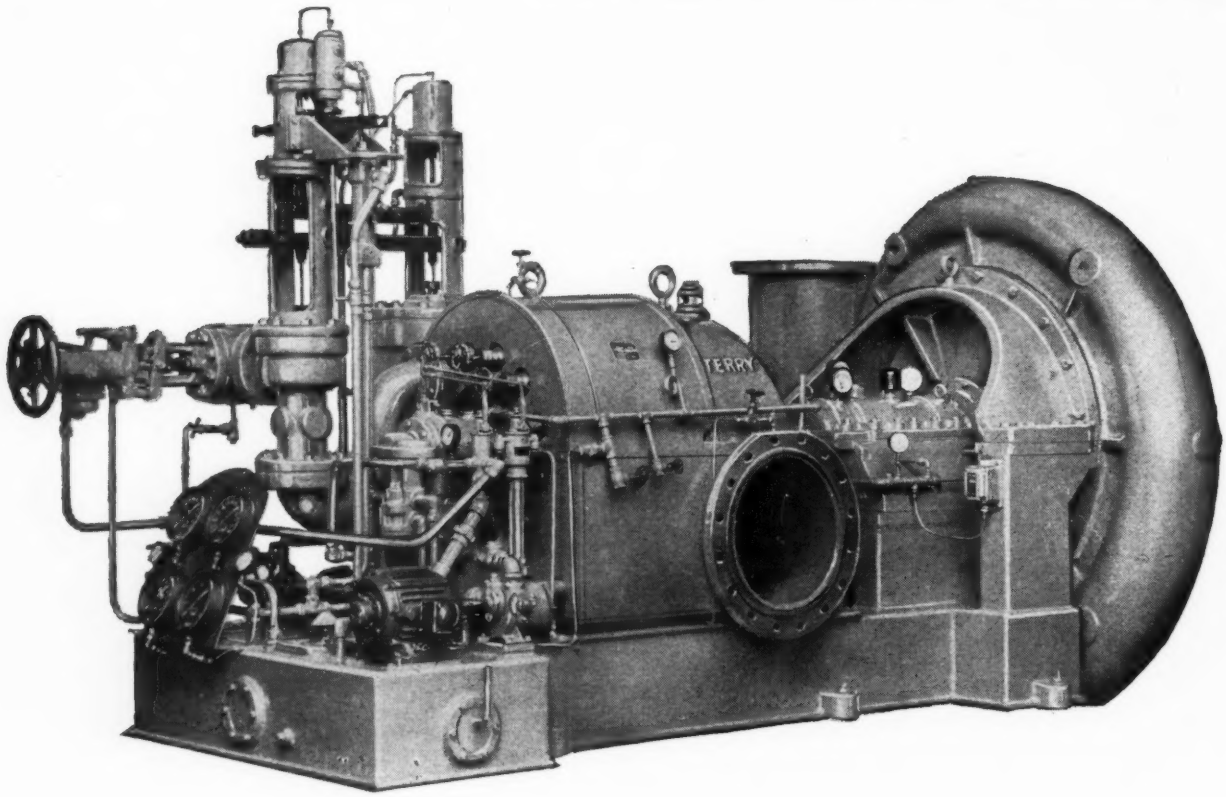
The TERRY TURBINE



SPECIAL PURPOSE TURBINE

FOR OPERATION UNDER ALL THESE CONDITIONS:

1. Straight, high-pressure, condensing
2. Straight, low-pressure, condensing — putting to work excess low-pressure steam.
3. Mixed pressure — using the low-pressure steam available, with only enough high-pressure steam required to drive the compressor
4. Condensing bleeder operation — providing clean, low-pressure steam for heating or process work

. . . and the speed under any of these conditions can be varied from 2800 to 4750 rpm.

This is but one example of many unusual combinations developed by Terry to meet out-of-the-ordinary requirements in turbines up to 2000 hp. Information on a special-purpose turbine for your specific requirements will be gladly furnished.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

T1177

Robins Gyrex Screen gives thrifty, dependable service on same installation since 1933

For more than 15 years the Robins Gyrex Screen pictured above has given low-cost service at the Mohawk Mining Co., Kittanning, Pa.

"It just runs on and on!" says D. H. Turner, Mohawk president.

Such long service is typical of what you can expect from Robins Gyrex Screens. You can use them for a wide variety of sizing or separating jobs—for coal, coke, gravel, stone, sand, rock, ore and many bulk materials.

Developed by Hewitt-Robins, the Gyrex vibrating screen is extremely versatile. It can separate as many as six different sizes at one time. It can size anything from fine hair to coarse rock. And it can handle hundreds of tons of bulk material every hour.

Once *you* install a Gyrex Screen, you will soon discover these five advantages:

1. Smooth operating. Has powerful vibration within itself. Yet *does not vibrate* the building or supports.

2. Versatile. Available in a weight to meet any class of service—a size to solve every problem. More than 300 models and styles.

3. Economical. Uses minimum of power per ton of material screened.

4. High capacity and efficiency. Uniform positive motion and correct centrifugal action.

5. Long life, low maintenance cost. All bearings super-sealed. All permanent connections electric-welded. All service connections jig-drilled for fitted bolts.

ROBINS

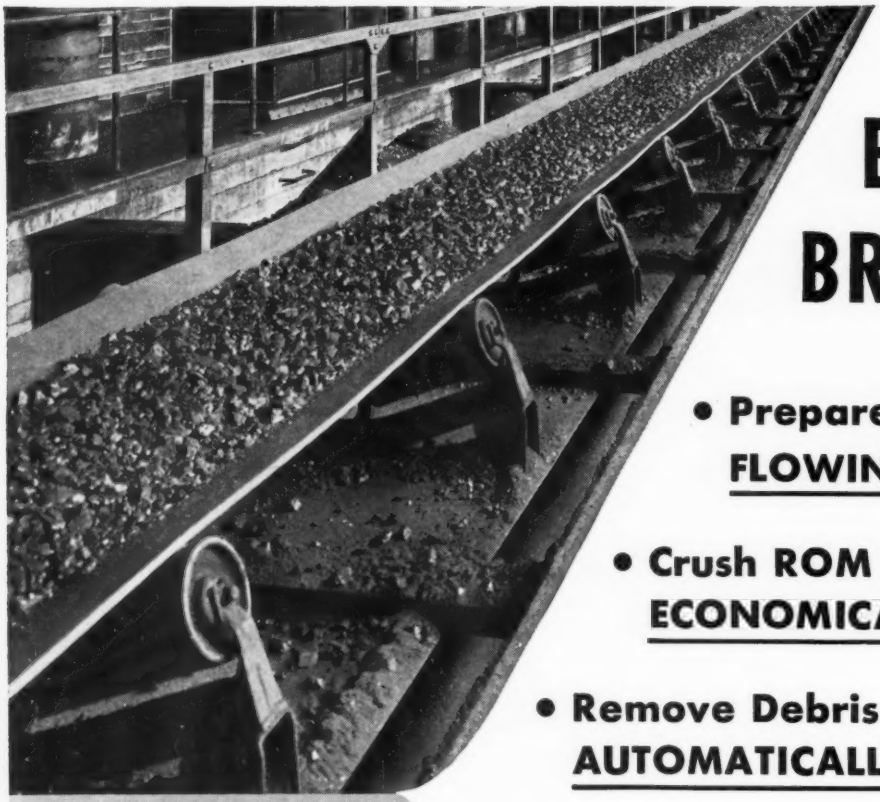
GYREX SCREENS

Consult Robins now. There's a Gyrex Screen to meet *your* exact needs.

SEND TODAY for Robins Bulletin No. 115-A. Fully illustrates and describes features, advantages and benefits of efficient Gyrex Screens. Address Robins Conveyors Division, 270 Passaic Avenue, Passaic, New Jersey.

ROBINS CONVEYORS DIVISION **HEWITT-ROBINS INCORPORATED**

"PENNSYLVANIA" STEELBUILT



BRADFORD BREAKERS

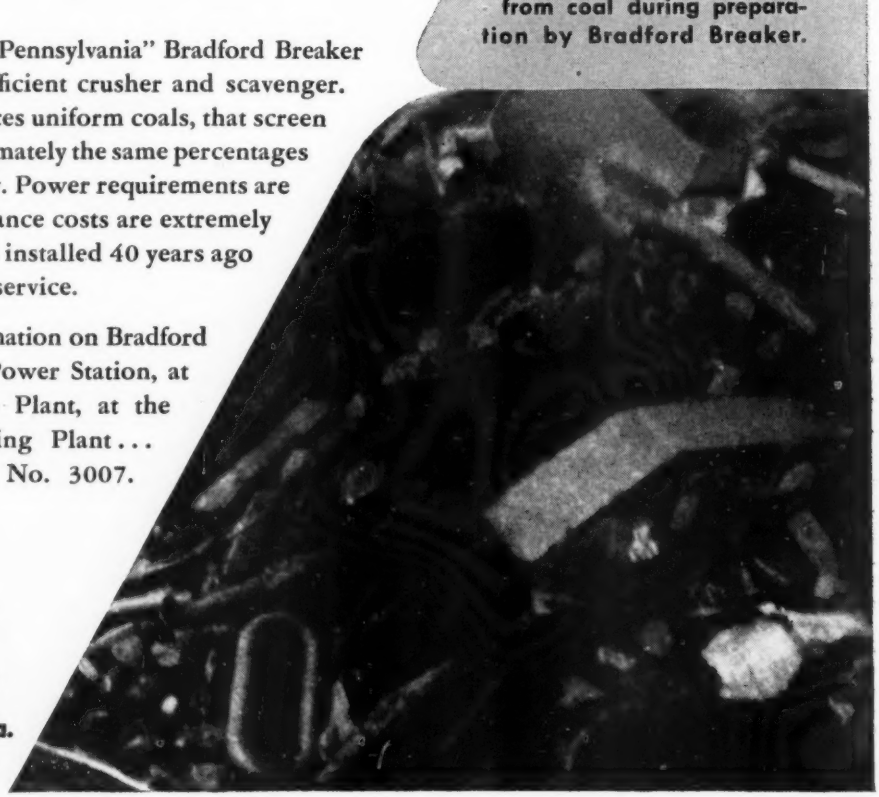
- Prepare FREE FLOWING Coals
- Crush ROM Coals ECONOMICALLY
- Remove Debris AUTOMATICALLY
- Eliminate Oversize COMPLETELY

Typical "Pennsylvania" Bradford Breaker prepared coal, just as it came from the breaker at a Central Station installation. (Unretouched photograph.) Uniform, no oversize, minimum fines.

The "Pennsylvania" Bradford Breaker is an efficient crusher and scavenger. It produces uniform coals, that screen to approximately the same percentages day after day. Power requirements are low. Maintenance costs are extremely small. Breakers installed 40 years ago are still in daily service.

For complete information on Bradford Breakers . . . at the Power Station, at the By-Product Coke Plant, at the Coal Mine and Cleaning Plant . . . write for new Bulletin No. 3007.

Typical pile of tramp iron and other refuse removed automatically from coal during preparation by Bradford Breaker.



PENNSYLVANIA CRUSHER COMPANY
DIVISION OF BATH IRON WORKS CORPORATION
Liberty Trust Bldg., Philadelphia 7, Pa.
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For BETTER TEMPERATURE CONTROL

GET A COPY OF NEW BULLETIN 329

It will help make it easy for you to select the simplest, most dependable type of control made for many of the following applications:

Water Heaters and Hot Water Line Control • Fuel and Crude Oil Heaters • Cooling water for Compressors, Diesels, Gas Engines and Transformers • Sprinkler Tank Heaters • Steam Heated Tanks, Vats, Dryers and Kettles • Dishwashers, Steam Tables and Coffee Urns • and many other uses. (11DG)

Quickly Pay Back Their Cost

Controlling heating operations they prevent OVER-heating—save fuel and labor—improve production.

Controlling cooling water for diesel, gas engines and compressors they help prevent OVER and UNDER cooling—increase operating efficiency and reduce consumption of cooling water.

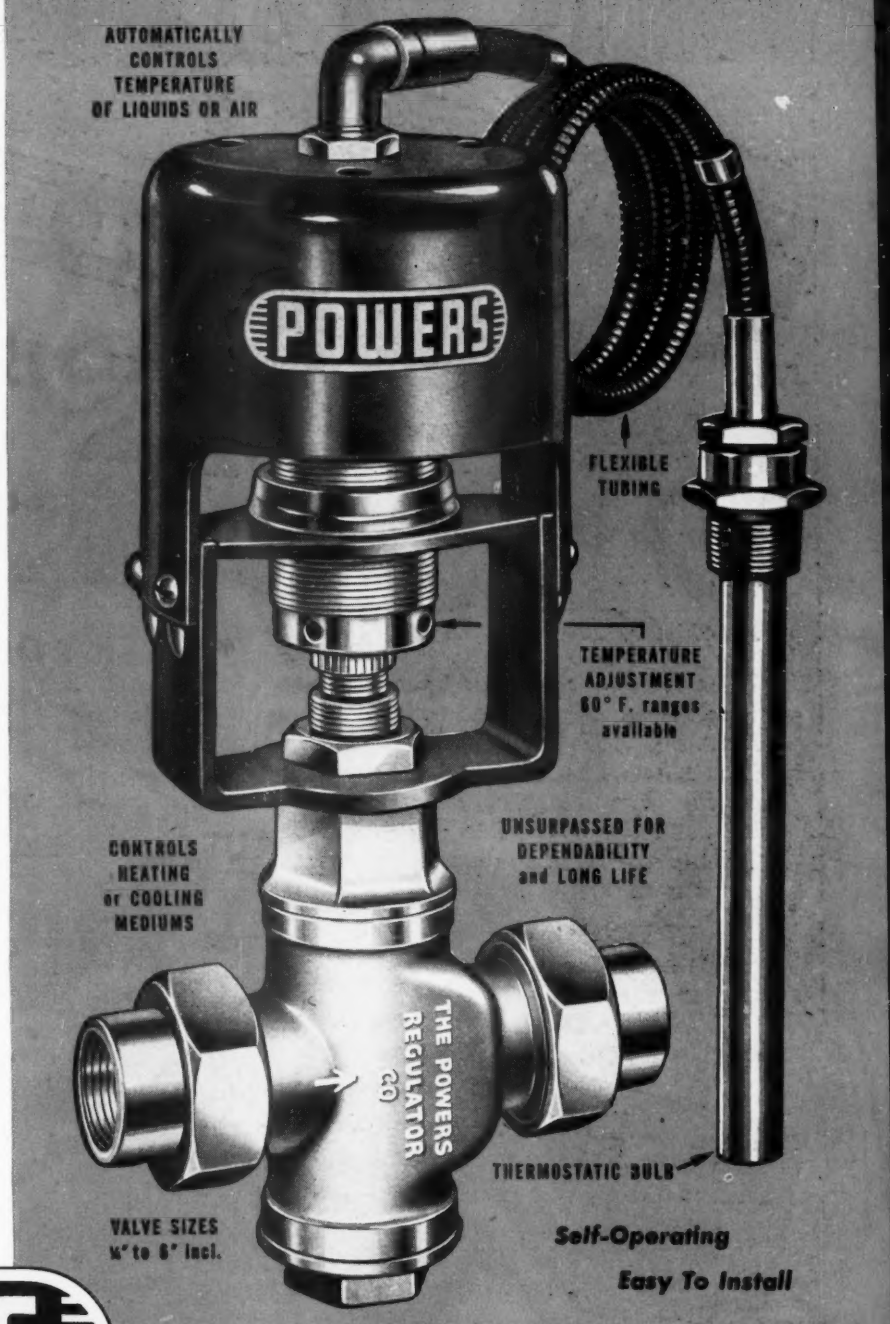
TYPES AVAILABLE: Direct and reverse acting regulators—Double Seat balanced valve, double unions ½" to 2" incl., flanged 2½" to 6" incl.—Single Seat valve double unions ¼" to 1½" incl.—3-Way valve ½" to 4" incl.—Temperature Indicating regulator—all are shown in new Bulletin 329. Get a copy and prices from our nearest office.

Use

POWERS

No. 11 INDICATING REGULATOR

Combining an easy to read dial thermometer with a self operating regulator was pioneered by POWERS in 1930. Thermometer has dial and is mounted on top of the regulator. Both thermometer and regulator operate from same thermal system. Only one tapped opening required. A visual check on performance of the regulator is provided and it is easy to adjust for different temperatures.



No. 11 REGULATORS

When you want a simple, rugged control to maintain a constant temperature with unfailing dependability . . . install a POWERS regulator. They often give 10 to 25 years of service and pay back their cost several times a year. No compressed air or electricity required. May be just the regulator to solve some of your temperature control problems. ***Write for Bulletin 329.***

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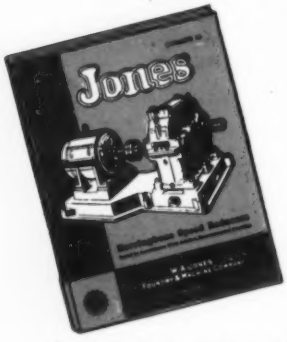
OFFICES IN 50 CITIES • SEE YOUR PHONE BOOK
Over 55 Years of Temperature and Humidity Control

SINGLE! DOUBLE! TRIPLE!

. . . . *Every type of Herringbone Speed Reducer that you might need*

Jones Herringbone Gear Speed Reducers are built in a wide range of ratios and ratings to cover every requirement. Single (Type SH) reducers in standard ratios range from 1.25 to 1 up to 11 to 1 in ratings from 1.3 to 440 H.P. Double (Type DH) reducers are built in standard ratios from 10.9 to 1 up to 72 to 1 in ratings from 0.5 to 275 H.P. The triple reduction reducers (Type TH) cover a range of ratios from 86.9 to 1 up to 355.8 to 1 in ratings from 0.3 to 78 H.P.

All these reducers have heat treated gears, ground shafts and are mounted with anti-friction bearings throughout. Cast iron bases are available for all variations of motor assembly. Liberal stocks are carried to facilitate shipments.



Here's Complete Information About the Application of Herringbone Reducers

This 128-page catalog of Jones Herringbone Reducers presents a vast amount of data relating to Herringbone Reduction Units. Illustrations show a broad range of herringbone reducer applications and the technical information shows how to select reducers for all conditions of service in accordance with the A.G.M.A. recommended practice.

Write for your free copy of this valuable treatise

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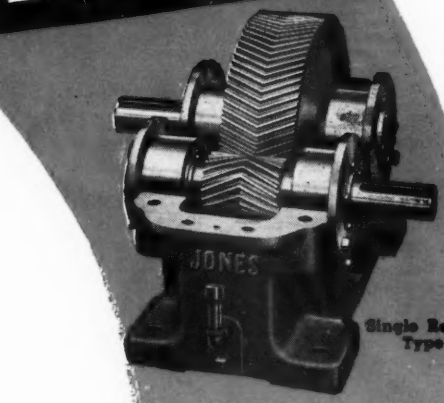
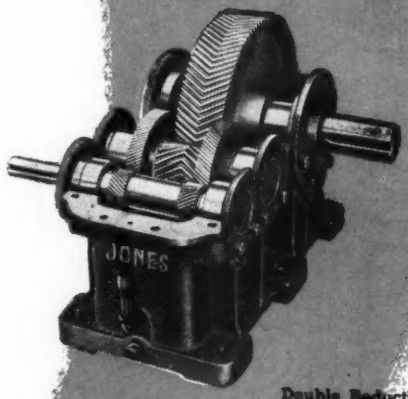
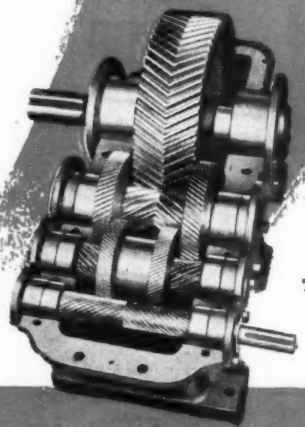


Single Reduction Type SH



Double Reduction Type DH



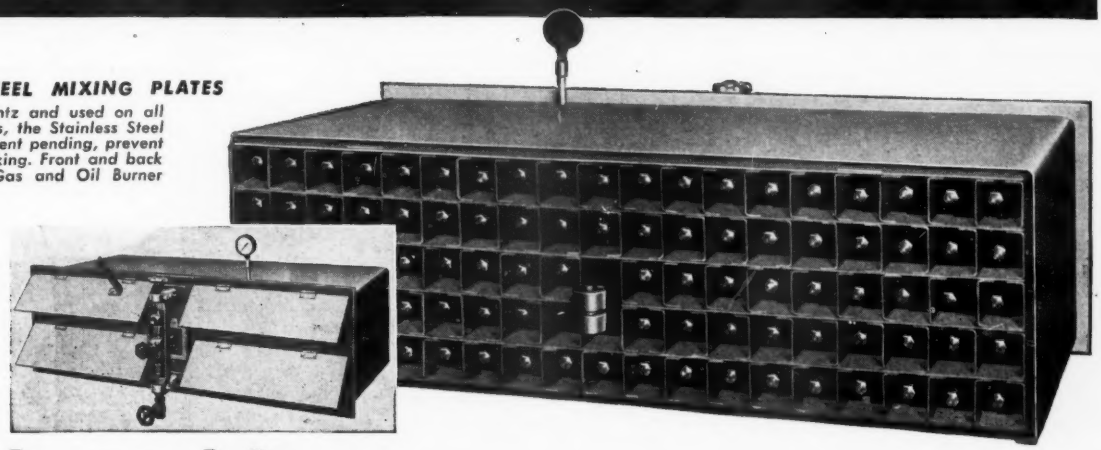
Triple Reduction Type TH

Jones

HERRINGBONE — WORM — SPUR — GEAR SPEED REDUCERS
PULLEYS • GEARS • V-BELT SHEAVES • ANTI-FRICTION
PILLOW BLOCKS • FRICTION CLUTCHES • FLEXIBLE COUPLINGS

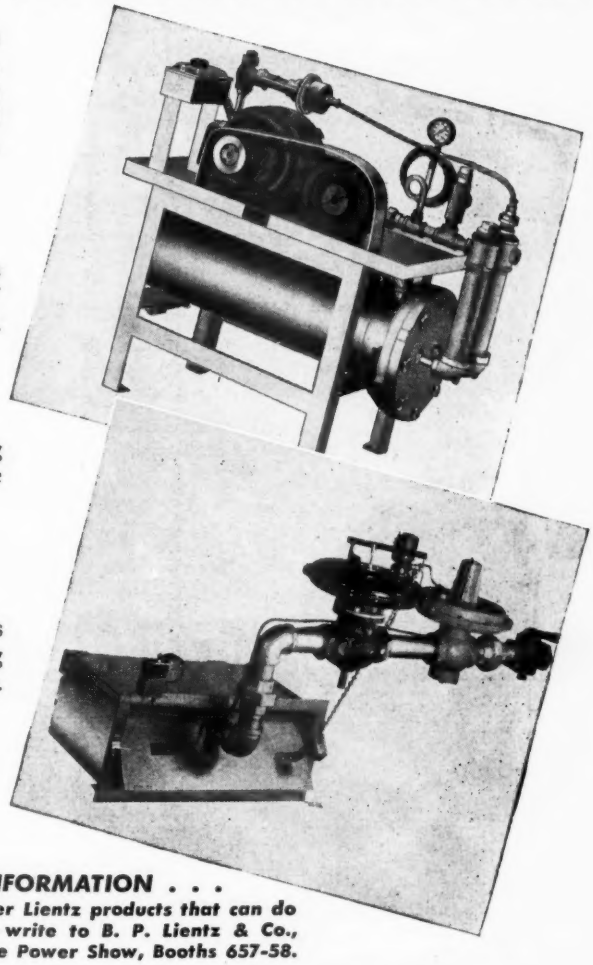
STAINLESS STEEL MIXING PLATES

Developed by Lientz and used on all Lientz Gas Burners, the Stainless Steel mixing plates, patent pending, prevent warping and cracking. Front and back of Combination Gas and Oil Burner illustrated.



Lientz always delivers Savings and Service where they count— in fuel conservation and lower maintenance costs

Hundreds of installations are still proving that Lientz solves industrial heat utilization problems—economically and efficiently. Working with the country's foremost combustion engineers has kept Lientz *"ahead"* in the fields of Heat Application, Heat Transfer and Heat Conversion. *Gas or Oil—they both burn better with Lientz.*



Combination Gas and Oil Burners

Series B-2-S Gas Burners provide a wide range of sizes with capacities to suit the requirements of any installation. With Lientz type "0" Oil Burner balanced stand-by. Adaptable to controlled operation.

Fuel Oil Pumping and Heating Units

Designed and built by Lientz—to your specifications. For handling all grades of oil in any capacity—preheated, and at the pressure needed for the most economical combustion of the fuel.

Packaged Gas Burners

Series "SP", in 5 sizes, for commercial installations where the needs range from 150,000 to 2,000,000 BTU's. Stainless Steel mixing plates and multi-orifice burner tips for efficient, radiant flame. Complete with controls, as illustrated.

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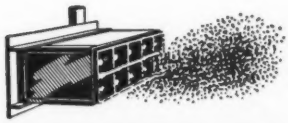
Combustion Equipment



WRITE FOR INFORMATION . . .

On these and other Lientz products that can do your job better — write to B. P. Lientz & Co., or see them at the Power Show, Booths 657-58.

P. O. Box 2275 **Kansas City, Missouri**

B. P. Lientz & Company

MANUFACTURING ENGINEERS IN INDUSTRIAL AND COMMERCIAL COMBUSTION EQUIPMENT FOR NEARLY HALF A CENTURY

putting the heat to enclosure problems

Build as high as you want

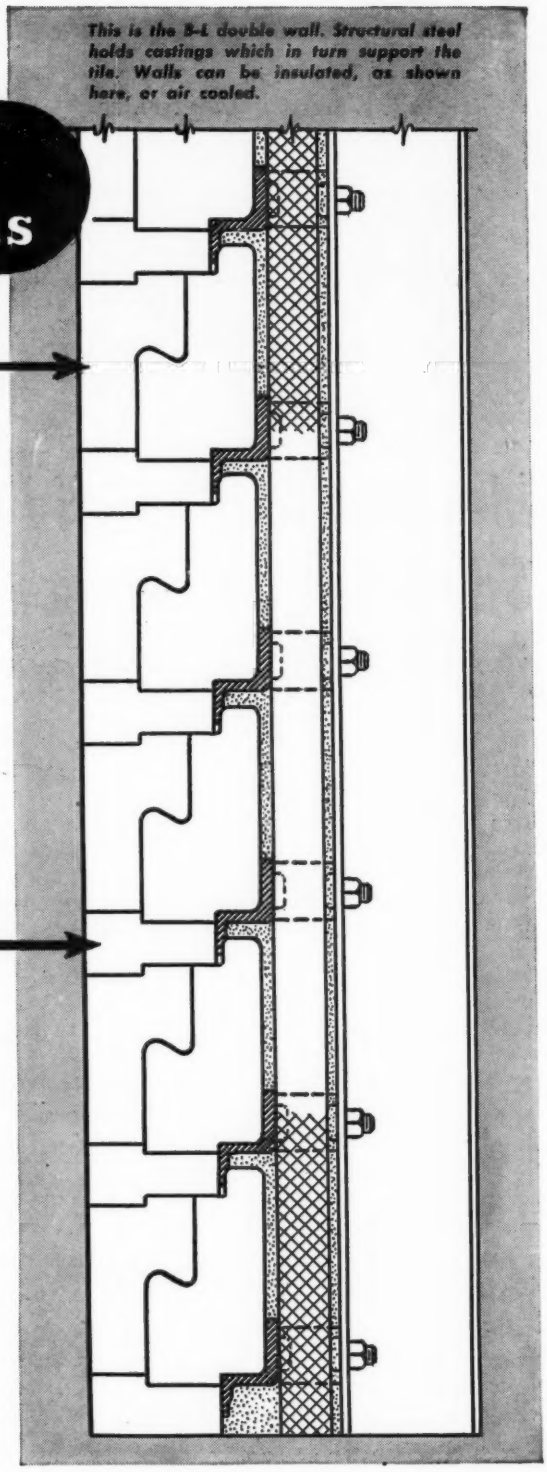
● Furnace enclosure problems are simplified when engineers can let flexibility work *for them* in the design of arches and walls.

For example, enclosures can be built to any height, width, or shape (using the principle of the modern skyscraper). Refractory thicknesses are set by service conditions, *not* proportioned to the heights of the walls. Many installations have thin walls in cool areas and thick walls in hotter portions.

Cumulative loading is out; unit-suspension means that no brick bears more than its own weight. Previously, the resulting load of brick piled upon brick made the bottom of the wall (where temperatures are usually highest) the most vulnerable.

Applications? wherever heat must be controlled—for boiler settings in power plants; for oil stills and cat crackers in refineries; for all kinds of driers and kilns and metallurgical furnaces.

No cumulative loading



This is the B-L double wall. Structural steel holds castings which in turn support the tile. Walls can be insulated, as shown here, or air cooled.

In a nutshell, the rest of the story is as follows:

1. Walls and arches feature "built in" stability; any portion can be removed for replacement without weakening adjacent areas. Design provides for thermal expansion.

2. Refractories are easy to replace without disturbing undamaged sections. Maintenance is simple, quick, economical.

3. Construction is air tight; heat losses are reduced. Maximum efficiency can be maintained and fuel used to full advantage.

4. B-L engineers co-ordinate enclosure requirements with problems of temperatures, types of firing equipment, and slagging and erosion possibilities.

For more information, write Detroit direct, or contact one of the offices listed below.

PIONEERS OF SUSPENDED CONSTRUCTION FOR INDUSTRIAL FURNACE ENCLOSURES . . .

BIGELOW LIPTAK Corporation

BIGELOW-LIPTAK

Unit-Suspended Walls + Arches

BIGELOW-LIPTAK CORPORATION

DIVISION OF A. P. GREEN FIREBRICK CO.

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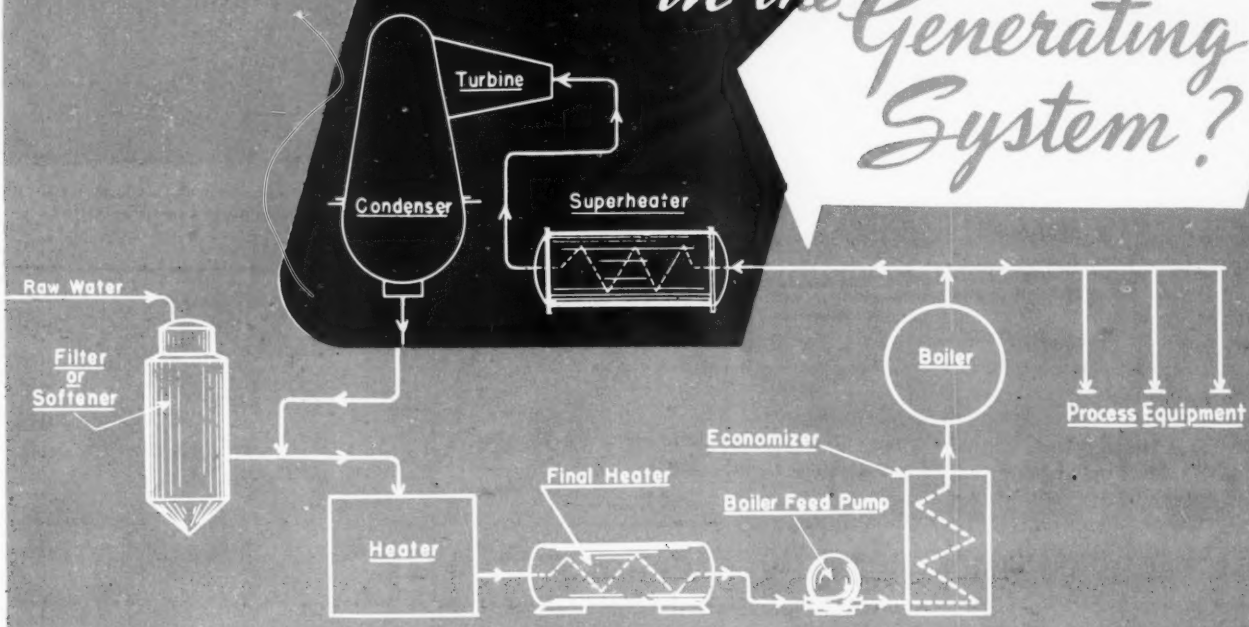
IS YOUR PLANT OPERATION SUFFERING FROM WATER TREATMENT PROBLEMS... *in the Generating System?*



Serious curtailing of output and decreased efficiency may result from deposits and/or corrosion on the steam-water side of the generating system.

Superheater—The chief problem encountered is deposits from carryover, which often cause tube burn-outs and lost efficiency. High temperatures, especially in localized areas, may lead to "dissociation" of the steam with resulting corrosion.

Turbine—Deposits from carryover are the main concern. In recent years, with increased pressures and temperatures, attention has also been directed to deposits due to vaporization of silica from boilers. Deposits of any kind may result in decreased capacity and efficiency, and often lead to frequent shutdowns for cleaning.

Condenser—On the steam side, serious problems are seldom encountered. However, corrosion may occur under certain conditions and deposits of iron oxide may form.

Condenser—On the water side, problems are more pronounced. In addition to deposits of "scale," other troublesome formations are slime and algae. Any of these deposits may decrease heat transfer with resultant loss of efficiency.

In order to correct these difficulties careful analysis of each problem is required. Corrective measures may range from simple chlorination, in the case of condensers, to complete boiler water treatment where deposits have formed in superheaters and turbines. Special water treatment measures may be required to eliminate vaporization of silica.

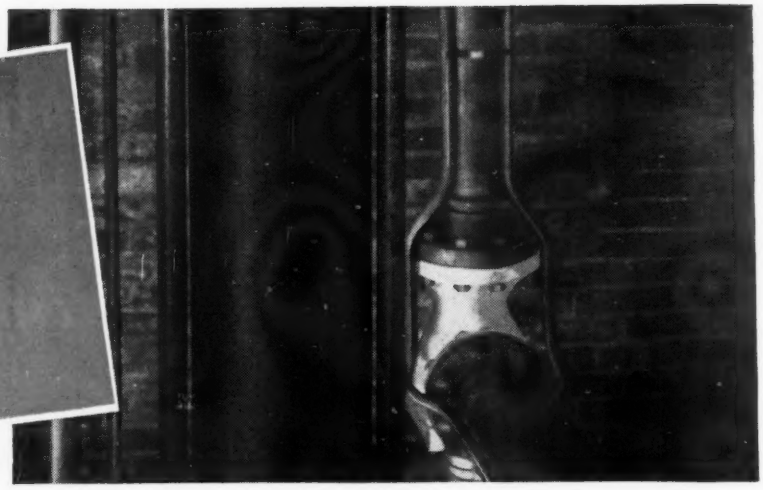
Some of these difficulties are probably present in your plant. Your local Drew Engineer will be glad to call and discuss your problem. No obligation.

POWER DREW CHEMICALS

E.F.DREW & CO. INC.
15 E. 26th ST., NEW YORK 10, N. Y.
Representatives in all key cities

BOILER WATER TREATMENT
COOLING WATER CONDITIONING

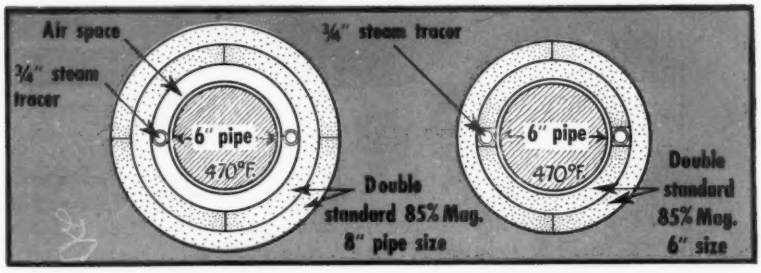
How would YOU insulate these hot lines?



HERE'S THE PROBLEM

Six-inch line carrying liquid asphalt at 470° F. has two ¾" steam tracer lines on opposite sides. Which of the insulation methods diagrammed below will prove most practical in this application?

HERE ARE TWO POSSIBLE SOLUTIONS



At left: Double standard thick 85% Magnesia, 8" pipe size. Applied outside all three lines.

At right: Double standard thick 85% Magnesia 6" pipe size, inner layer cut to fit between steam tracer lines.

THE ARMSTRONG ENGINEER RECOMMENDED:

The second method is preferable in this case, even though it is slightly less efficient than the first on a heat transfer and heat loss basis. Calculations on this job indicated that these factors had a negligible effect on over-all performance.

It is obvious that the second method makes a much stronger job mechanically. All the insulation fits tight against the lines and can be wired to them firmly. In addition, there is a worth-while saving in using molded insulation of the smaller size.

In almost every heat insulation job, there's some opportunity for fresh thinking. But, to be sound, it must always be teamed up with expert engineering and long experience. That's what you get when you call in Armstrong's Contract Service—ingenuity plus sound "know-how." And Armstrong's engineers, working with a complete line of top-quality materials, can specify the best insulation for each phase of the job. They know, also, that it will be applied correctly by Armstrong's trained insulation mechanics.

Actual installation by Armstrong mechanic

FREE INSULATION CHART

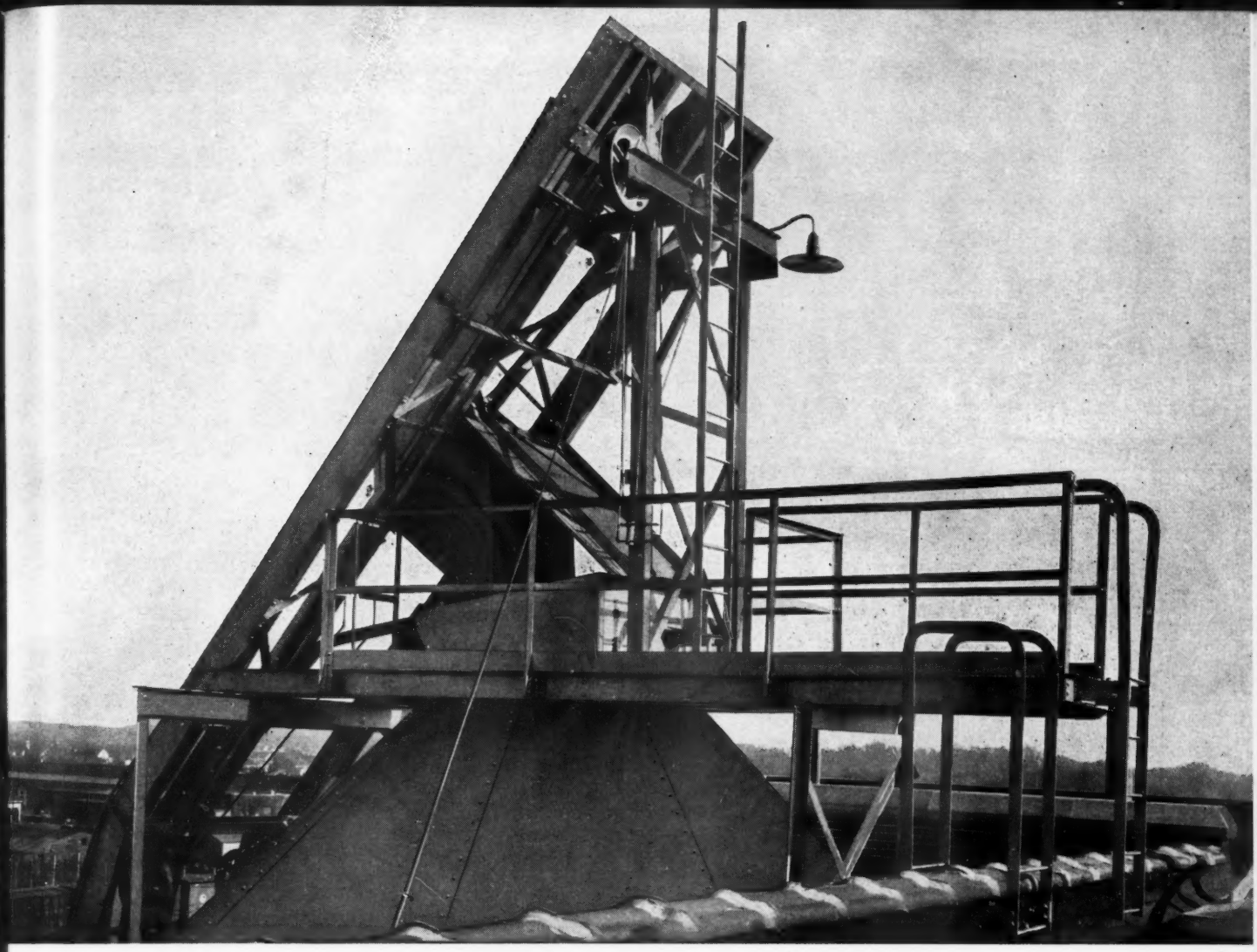
This chart lists types and thicknesses of insulation for temperatures from 300° below zero to 2800° F. Write for your copy to Armstrong Cork Co., Industrial Insulation Dept., 7012 Maple Avenue, Lancaster, Pa.

ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service For All Temperatures

From 300° Below Zero

To 2800° Fahrenheit



Broadening the Horizon
with their efficiency and economy

BARTLETT-SNOW SKIP HOISTS tick away the years to the rhythmic travel of their buckets. They have demonstrated their outstanding efficiency and dependability for handling limestone, sand, ashes, ores, sinter, and many other services when the lift is high and the material heavy or abrasive.

Skip Hoists have been widely used in handling coal in industrial boiler plants (see view of industrial head frame above) and because of the inherent advantages of their design have proven extremely well adapted for use in large central stations.

Skip Hoists have very few moving parts. Consequently they incur little wear and require little maintenance and repair. They are readily adaptable to receiving coal by rail, truck or waterway, and to coal storage and reclaiming systems using either a drag line or bulldozer.

Skip Hoists can be mounted inside ornamental type buildings. Because they are relatively unaffected by summer sun, or winter's ice and snow, they can also be mounted entirely outside the building. In either case they require a minimum of cubic space and little ground area. Furnished in a wide range of sizes;—semi-automatic or fully-automatic, counter-weighted or counter-balanced types to meet any capacity and operating requirement.

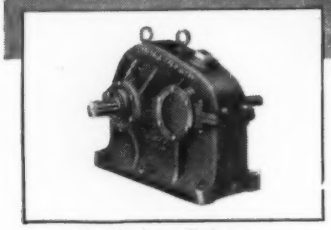
Send for a copy of our Bulletin No. 89. It describes Bartlett-Snow Skip Hoists in much detail,—and let Bartlett-Snow engineers, who perfected and installed the first commercially successful fully automatic skip hoist (still in use today), work with you on your next bulk handling problem. The C. O. Bartlett & Snow Company, Cleveland 5, Ohio. Engineering representatives in New York, Baltimore, Detroit and Chicago.

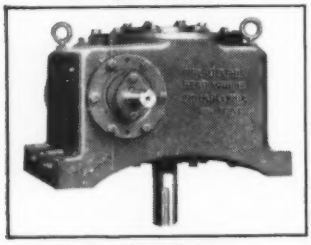
BARTLETT-SNOW
CLEVELAND 5, OHIO

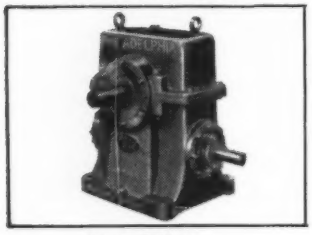
COAL HANDLING SYSTEMS
for
CENTRAL STATIONS AND INDUSTRIAL BOILER PLANTS

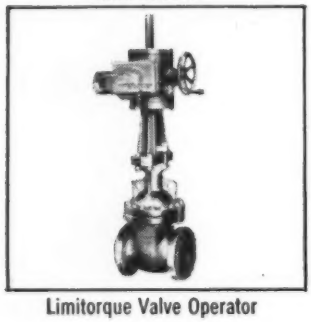
IT PAYS TO MAKE "ONE MANUFACTURER"
RESPONSIBLE FOR ALL YOUR SPEED REDUCER PROBLEMS

PHILLIE GEAR


Herringbone Reducer

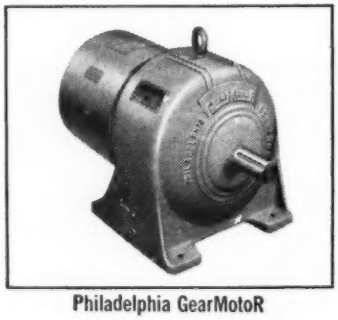

Vertical Worm Reducer

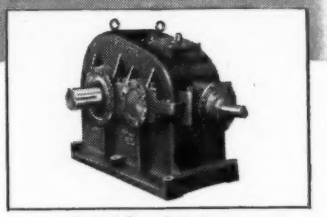

Worm Reducer

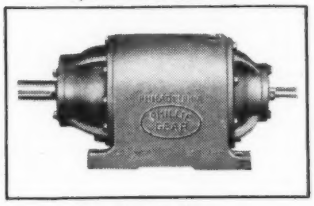

Limitorque Valve Operator

SEE US—BOOTH 44B—POWER SHOW

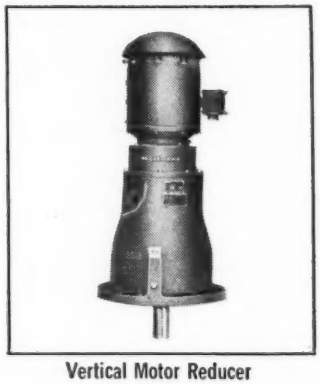
We design and manufacture *"every type and size"* of Speed Reducer. . . . This fact is important, because: 1) It assures the purchaser of our "unbiased" recommendations; 2) Permits ordering from "one source" of supply, and 3) enables the purchaser to place the *responsibility* for the operation of their Speed Reducers upon the shoulders of "one manufacturer."


Philadelphia GearMotoR


Spiral-Bevel Reducer


Planetary Reducer

"AirKooled" Worm Reducer


Vertical Motor Reducer

For over 56 years, we have "specialized" in the design and manufacture of Gears and Gear Driven Products. In fact, we were one of the "Pioneers" in this line. Also, we were one of the first firms to produce Speed Reducers for industrial purposes.
Today, "Phillie Gear" has one of the largest and most modernly equipped gear plants in the country. Your inquiries are invited for information on any type of Gear or Gear Driven Product, which, of course, includes the widely used *"LimiTorque" Valve Control.*
For catalog on any product, please use your Business Letterhead when requesting same.

Philadelphia Gear Works, INC.

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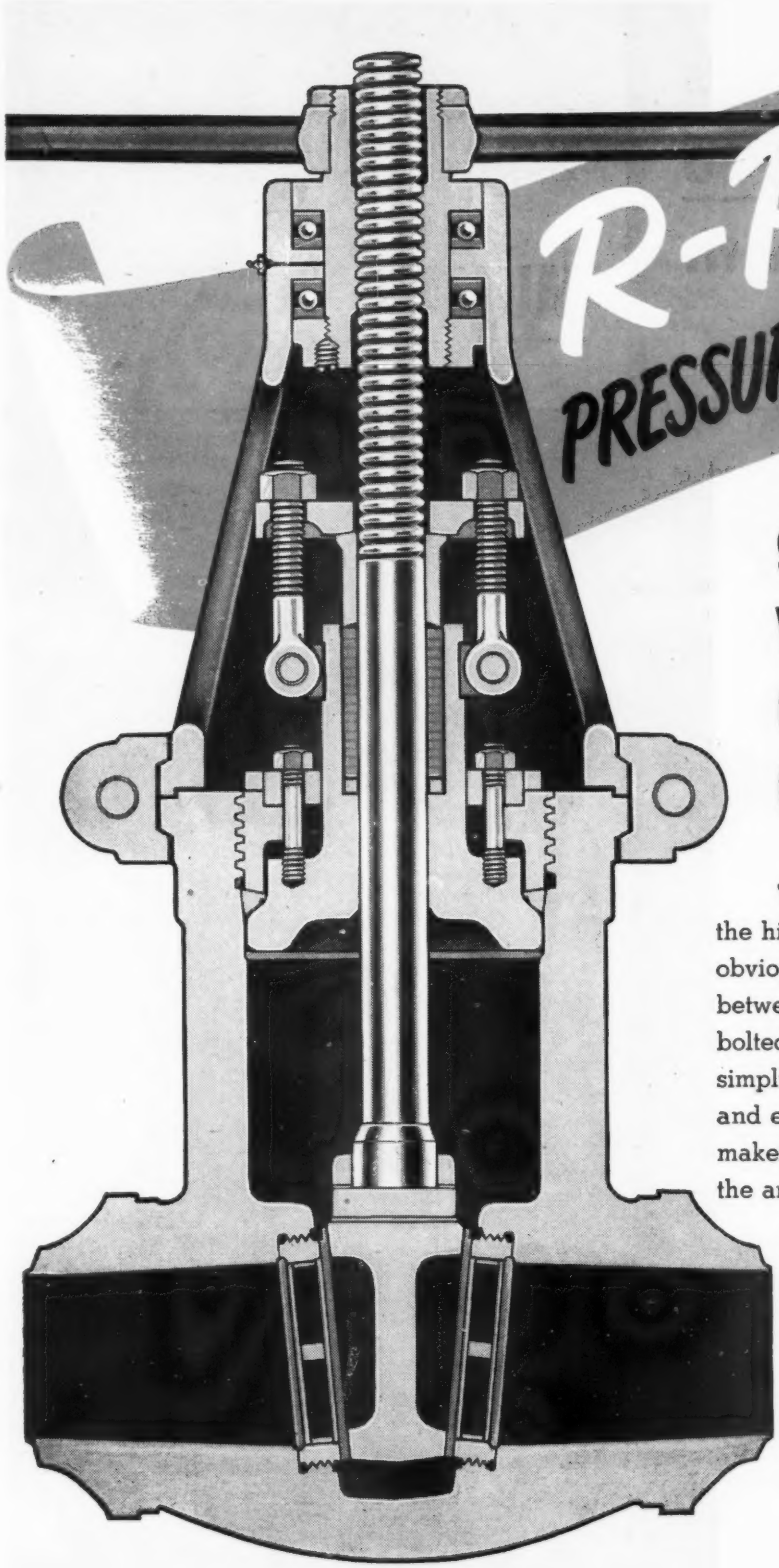
IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls



R-P & C PRESSURE SEAL BONNET

900# and 1500# Welding End Cast Steel Gates, Globes and Angles

THE ADVANTAGES of this construction in the high-pressure, high-temperature ranges are obvious. Internal pressure effects a tight seal between body and bonnet without need for a bolted joint. Inspection and service are greatly simplified. Reduced weight cuts cost of handling and erecting. Over-all contour of the valve makes it easier to insulate and reduces the amount of insulation required.

Our booth at the Power Show is No. 71. Stop in and see our Pressure-Seal Bonnet 1500# Gate Valve.

We will also be showing Electric Cast Iron Valves and some other interesting items in our line.

ACCO

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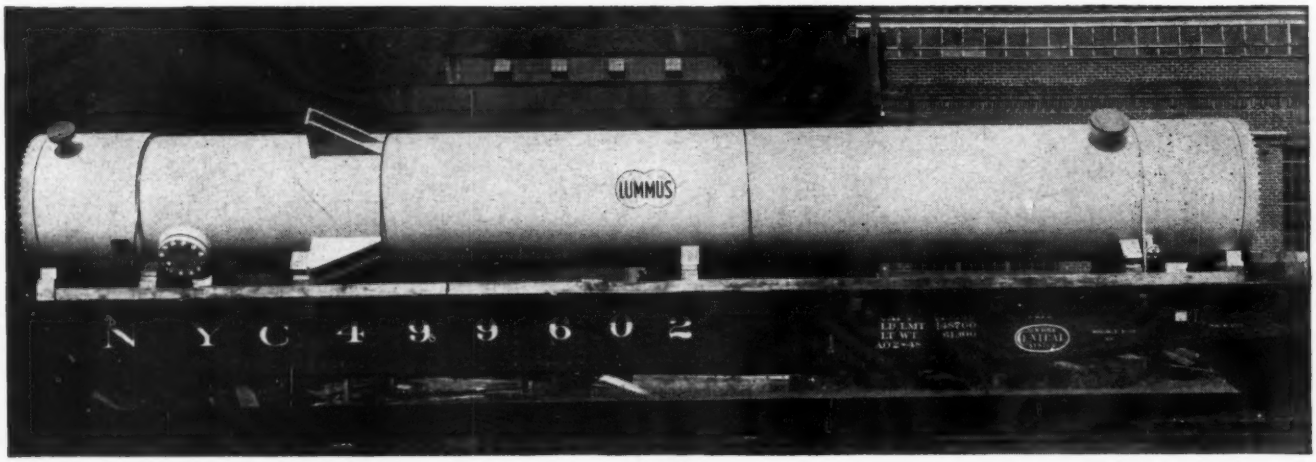
READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE

READING-PRATT & CADY VALVES

TRADE MARK

Its closures show how you will save with MULTILOK



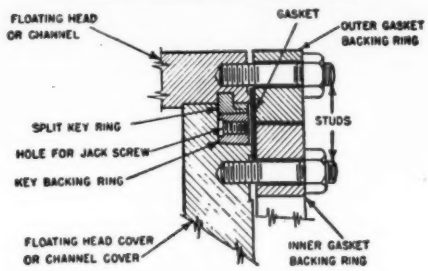
One of two identical Lummus units now in service at a well known refinery. Operating pressure, 1,050 psi. Tube surface, 3,140 sq. ft. Shell, 48 in. diam. Length over-all, 35 ft. Sure, tight closures are Lummus patented Multilok design.

This catalyst reactor is only one of many types of high-pressure equipment that have the advantages of Lummus patented Multilok Closures. These trouble-saving, cost-saving closures are used on feed water heaters, refinery, chemical, and general industrial high-pressure units—both with stationary and with floating heads.

Lummus heat exchangers are operating through wide temperature ranges at pressures varying from high vacuum to extremely high pressure. Conventional through bolting and backing ring construction are used for low and intermediate pressures. Multilok is used for pressures of 750 psi and higher.

For highest operating efficiency with lowest maintenance, have Lummus bid on all your heat exchanger requirements.

TYPICAL MULTILOK ASSEMBLY



No heavy, hard-to-handle bolting is required to hold the pressure. Thick, costly flanges are avoided. Gaskets are outside the head and can be replaced, if ever necessary, without removal of the head.

THE LUMMUS COMPANY
Heat Exchanger Division
259 West 14th Street, New York 11, N. Y.

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ENGINEERS design and supervise every step in the manufacture of WeldELLS and Taylor Forge Flanges to meet the most exacting requirements of the most exacting customer.

Taylor Forge engineers have spent a good many years meeting special needs for unusual piping installations around the world and in every basic industrial field.

This is an important reason why engineers in thousands of companies turn to Taylor Forge when their problems are tough.

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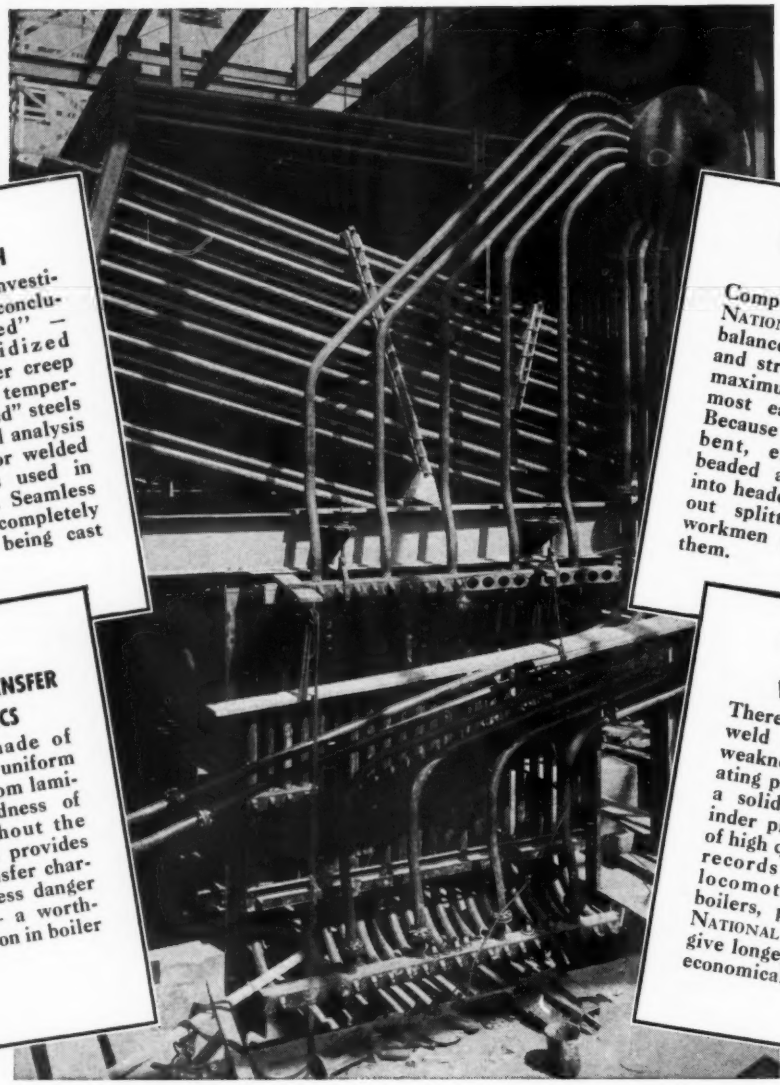


HIGHER CREEP STRENGTH

Tests by impartial investigators have shown conclusively that "killed" — thoroughly deoxidized steels — have better creep strength at elevated temperatures than "rimmed" steels of similar chemical analysis commonly used for welded tubes. *All* steels used in U·S·S NATIONAL Seamless Boiler Tubes are completely "killed" before being cast into ingots.

BETTER WORKING PROPERTIES

Complete annealing gives NATIONAL Tubes the right balance between ductility and strength which assures maximum service and utmost ease of installation. Because they can be readily bent, expanded, flared, beaded and rolled tightly into headers or sheets without splitting or fracture, workmen prefer to install them.

SUPERIOR HEAT TRANSFER CHARACTERISTICS

Seamless tubes made of "killed" steels have uniform density, freedom from laminations and soundness of structure throughout the metal walls. This provides superior heat transfer characteristics with less danger of "hot spots" — a worthwhile consideration in boiler tube service.

"WALLS WITHOUT WELDS"

There is no longitudinal weld or line of potential weakness to limit safe operating pressure. Each tube is a solid, homogeneous cylinder pierced from a billet of high quality steel. Service records from stationary, locomotive, and marine boilers, prove that U·S·S NATIONAL Seamless Tubes give longer, safer, and more economical service.

These 4 basic advantages PAY OFF

when you're handling extreme pressures, high temperatures or complicated assemblies

THAT's why so many public utilities and other high pressure steam plants have standardized on U·S·S NATIONAL Seamless Boiler Tubes. To the Seamless Process of tube making —pioneered by NATIONAL—can be credited much of the advance made in more efficient steam production.

Piercing a tube from a solid billet of steel is the only process that absolutely removes all uncertainty regarding uniform wall strength—that provides the structural homogeneity and the assured safety, security, and dependability of a solid forging.

What is equally important, these superior "Walls Without Welds" have been continually improved, both in their metallurgy and in their fabrication, to insure lasting safety and economy under increasingly heavier loads.

NATIONAL TUBE COMPANY, PITTSBURGH, PA.
(TUBING SPECIALTIES DIVISION)
COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

NATIONAL WALLS WITHOUT WELDS *Seamless*

BOILER TUBES

UNITED STATES STEEL

WHY SHOP FOR A BOILER??

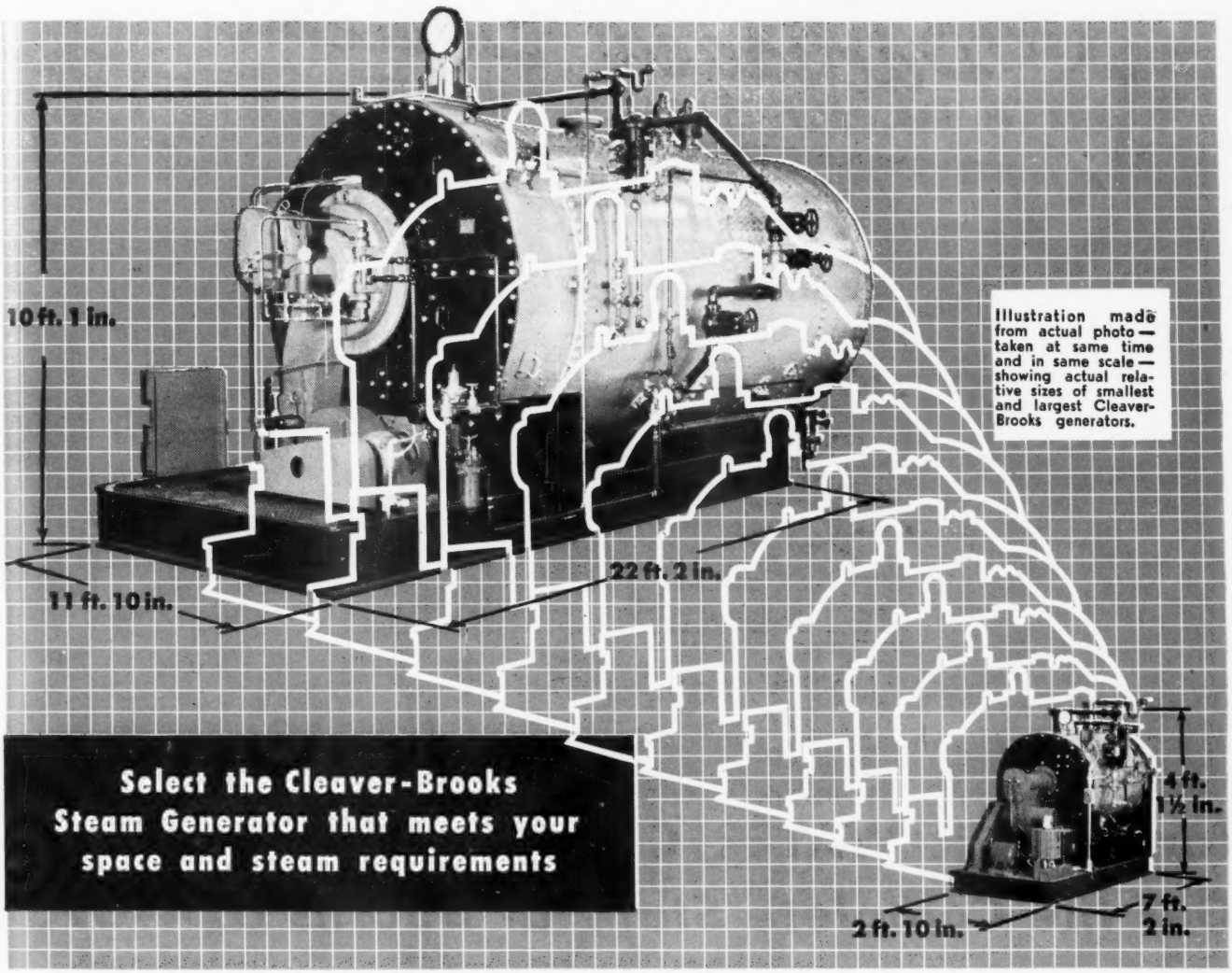


Illustration made from actual photo — taken at same time and in same scale — showing actual relative sizes of smallest and largest Cleaver-Brooks generators.

Select the Cleaver-Brooks Steam Generator that meets your space and steam requirements

WHY search and shop for a boiler — install a Cleaver-Brooks engineered and packaged steam generator that fully meets your steam requirements and needs only a minimum of space and headroom.

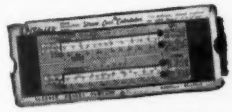
You can select from a range of sizes 15 to 500 hp. — and you can have your Cleaver-Brooks steam generator equipped for oil, gas, or with a combination burner which permits alternate use of gas or oil and provides for a quick change-over from one fuel to the other.

Equally important — you get Cleaver-Brooks guarantee of at least 80% efficiency from full load down to 30% of rating — with either gas or oil as fuel — and IN ALL SIZES.

Cleaver-Brooks steam generators enable you to burn the available fuel in your area — give you clean, smokeless operation—eliminate fuel and ash handling — need no high or costly stacks — no special foundations — fit under low headroom and into limited space — provide flexible operation to meet fluctuating loads — fully meet all codes.

Oil or Gas Fired . . . Guaranteed 80% Efficiency from Full Load Down to 30% of Rating . . . IN ALL SIZES

Available in a size to fit your needs — 15 to 200 p.s.i., 15 to 500 hp.—write for Cleaver-Brooks Steam Generator bulletin.



WRITE on your business letterhead for Free Steam Cost Calculator — a ready reference slide rule showing the comparative steam costs when using oil, gas or coal as fuel.

CLEAVER-BROOKS COMPANY, 332 E. Keefe Ave., Milwaukee 12, Wis.

Cleaver-Brooks

"Packaged" STEAM GENERATORS

HAVE SERVED INDUSTRY FOR MORE THAN FIFTEEN YEARS

"Packaged" Systems

for BOILER WATER CHEMICAL TREATMENTS

Get the Complete Story at Booths 674-675

The necessity is well recognized for feeding various chemicals to boilers for the prevention of scale and to control alkalinity, remove dissolved oxygen, protect against embrittlement and insure against corrosion and pitting caused by impurities in the boiler feed water. Practically all competent authorities agree that two distinct methods for conditioning boiler water are necessary.

First, sodium sulfite should be fed continuously to the suction side of the boiler feed pump to react with and remove any residual dissolved oxygen in the boiler feed water. This is necessary because oxygen in the water will act to corrode and pit the boiler feed water pump, economizers and boiler drums and tubes.

Second, other internal treating chemicals should be fed directly into the boiler drums to precipitate incrusting solids, to control alkalinity, and to give a chemical balance in the boiler to prevent corrosion and embrittlement.

Typical Milton Roy "Packaged" Systems for boiler water treatment are illustrated above. These systems are complete, include all necessary solution tanks, covers, gage glasses, low-level cutouts and alarms, motor starters and pumps as required. Automatic electronic controls can be supplied to operate pumps at speeds proportional to feed water flow as measured by flow meters. Systems are available to handle all treating chemicals and to meet all capacity and pressure requirements.

See us at Grand Central Palace, Booths 674-675 for complete information, Bulletin 4811 and Technical Paper No. 51 "What the Power Engineer Needs to Know about Chemical Feed Systems."

MILTON Roy COMPANY

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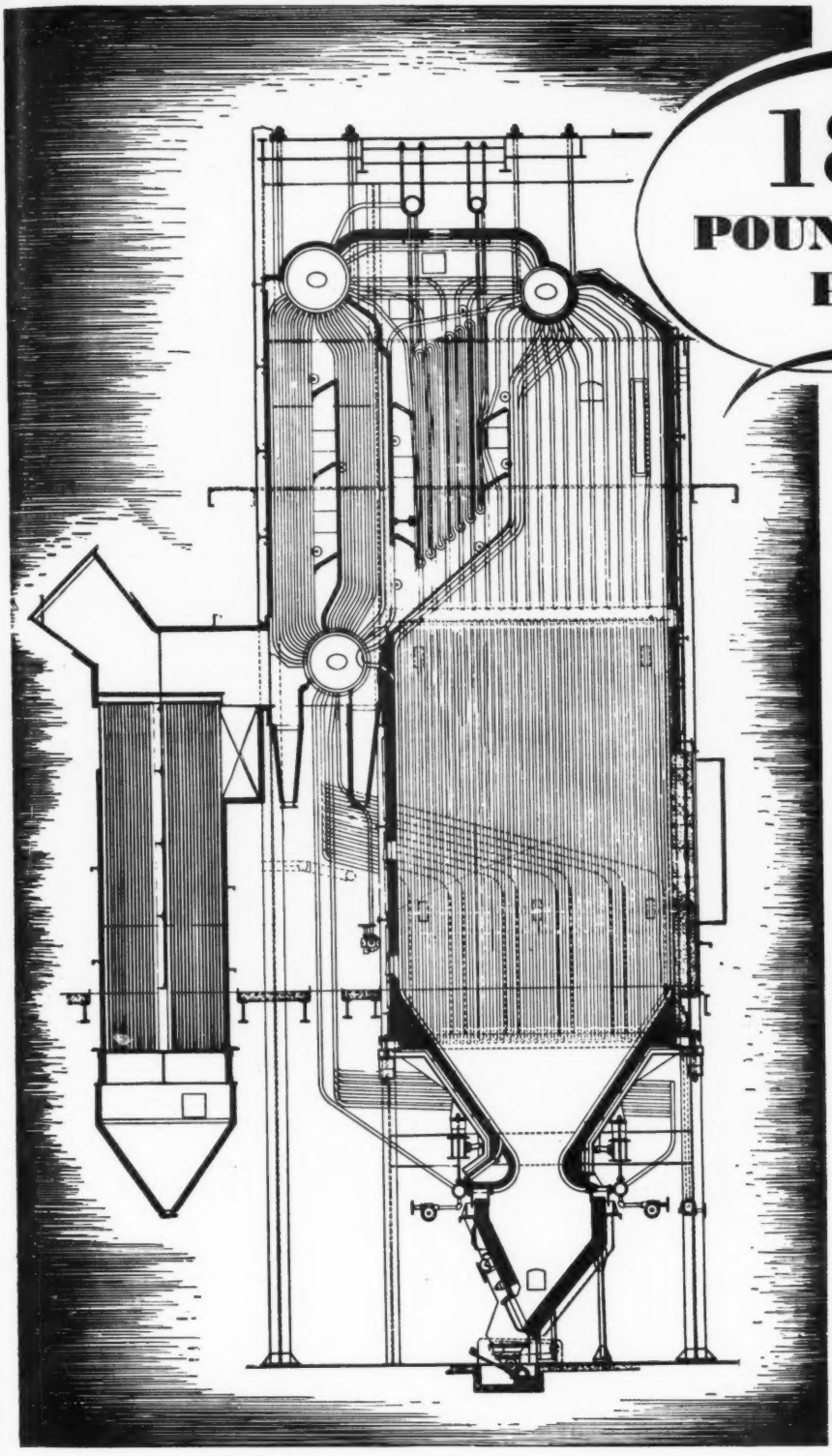

185,000
POUNDS OF STEAM PER HOUR

Purchaser—
Pennsylvania Electric Company

Location—
Front Street Station, Erie, Pa.

Number of Boilers 2

Pounds of Steam/Hr. . 185,000

Design Pressure . . . . 750 PSI

Operating Pressure . . 675 PSI

Total Temperature . . 835° F.

Air Preheater—
Erie City Tubular—2 Pass

Water Walls—
Erie City Bare Tube

Temperature of Air for
Combustion—530° F.

Four additional Erie City Units at higher pressure and temperature are now in production for the same company.

STEAM POWER PLANT EQUIPMENT

Complete Steam Generators • Type C 3-Drum Boilers • Type VL 2-Drum Boilers • The "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • Coal Pulverizers • Underfeed Stokers and Welded Pressure Vessels for the Process Industries.

ERIE CITY
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ERIE CITY IRON WORKS • ERIE, PA.

IT'S TAPER-LOCK! IT'S REVOLUTIONARY!

The simplest, surest mechanism ever devised for holding wheels to shafts. Another Dodge "first" —and the biggest development in this field in years!

The TAPER-LOCK Sheave breaks all speed records in mounting. Slip it on, line it up and tighten while sighting! Saves time—saves money.

Easy on, easy off! Disengages with less effort; holds fast to the shaft with firmness equivalent to a shrunk-on fit.

No flange. No collar. No protruding parts. Close mountings are possible. Bushing extends entire length of hub. TAPER-LOCK runs *true*.

A complete unit—in a complete range of sizes in Dual Duty (A and B); B, C, and D grooves. Write us for detailed bulletin, A175C, on this new and different taper bore sheave.

DODGE MANUFACTURING CORPORATION
Mishawaka, Indiana

DODGE

of Mishawaka, Ind.

CALL THE TRANSMISSIONEER

He is your local Dodge Distributor—factory trained—qualified to suggest ways to improve your machine performance, increase production. Look for his name under "Power Transmission Equipment" in your classified phone book.

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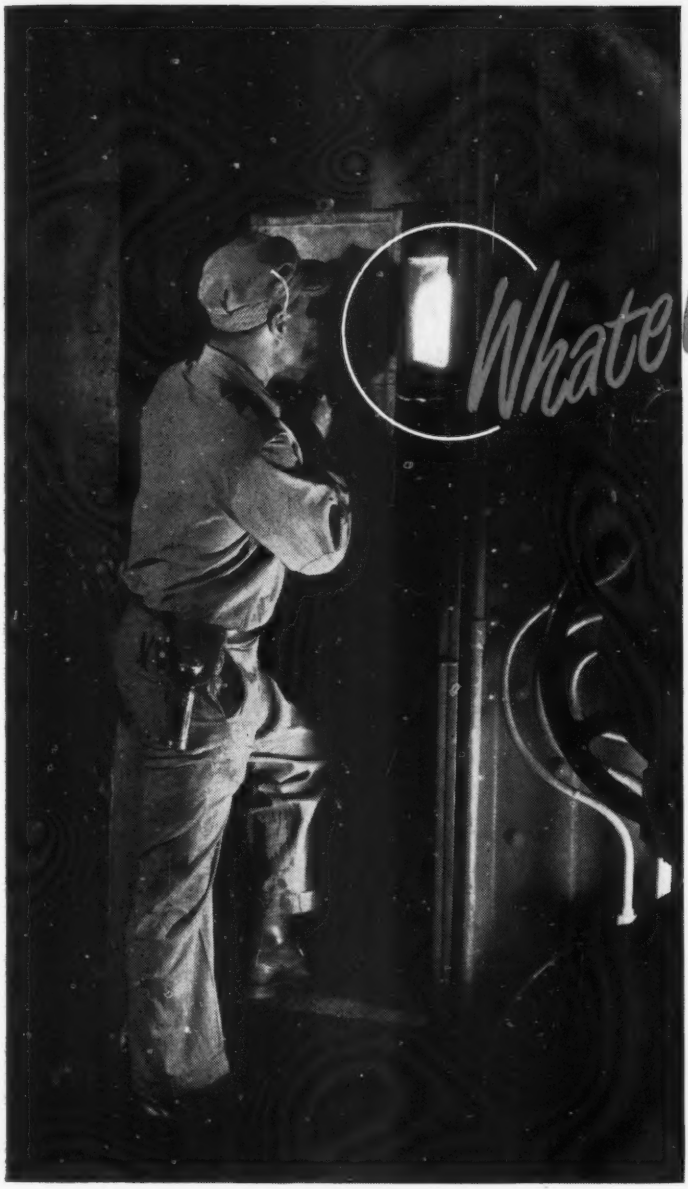
NAME PLATES
FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY, ETCHING COMPANY OF AMERICA, 1520 MONTANA STREET, CHICAGO 14, ILLINOIS



Whatever the temperature...

there is a

HARBISON-WALKER REFRACTORY

for every heating zone

You get longer service from your boiler settings and reduce your maintenance costs when you select the correct refractories from the complete Harbison-Walker line.

The grade of refractory needed depends upon the individual characteristics of the furnace—the type of boiler, fuel, method of firing, operating practice. The properties you want in your refractories include resistance to fusion, fluxing and erosion, spalling and mechanical damage.

Through many years of close association with boiler manufacturers and power plant operators, Harbison-Walker has gained intimate knowledge of service requirements.

For greatest overall economy and satisfaction, standardize on Harbison-Walker refractories!

HARBISON-WALKER PRODUCTS FOR POWER PLANTS

Harbison-Walker offers a wide variety of high duty, super-duty and high alumina refractories in standard and special shapes, plastics, castables and mortars. Shipments are made from conveniently located plants or warehouses Our technical organization will gladly help you select the exact grades and types of Harbison-Walker refractories best suited to your individual needs.

See our exhibit at the Power Show, booth no. 14.

Harbison-Walker Refractories Company

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WORLD'S LARGEST PRODUCER OF REFRACTORIES

GENERAL OFFICES PITTSBURGH 22, PA.

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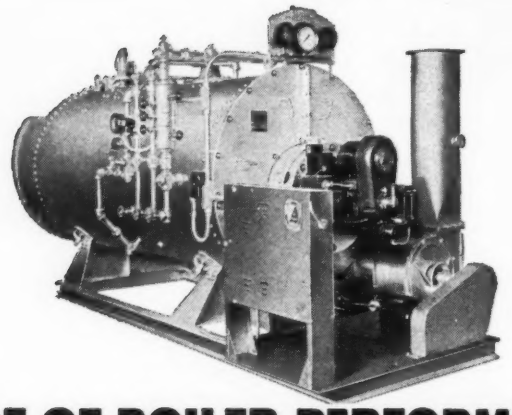

PROOF OF BOILER PERFORMANCE:

REPEAT ORDERS

from....

ALLIED CHEMICAL AND DYE CORP.
ALUMINUM COMPANY OF AMERICA
ASSOC. LAUNDRIES OF AMERICA, INC.
AUSTIN COMPANY
JOSEPH BANCROFT AND SONS CO.
CANADA DRY GINGER ALE, INC.
CHESAPEAKE AND POTOMAC TELEPHONE CO.
CITY OF NEW YORK
COCA COLA BOTTLING CO.
COMMONWEALTH OF VIRGINIA
CRANE COMPANY
DOUBLEDAY AND CO., INC.
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GULF OIL CORP.
HABITANT SOUP COMPANY
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LUX CLOCK MFG. CO.
NATIONAL BATTERY CO.
PEPSI-COLA BOTTLING CO.
RUTGERS UNIVERSITY
SPERRY PRODUCTS, INC.
STATE OF NEW JERSEY
UNITED CARR FASTNER CORP.
...AMERICA, INC.

These leading American enterprises—with complete confidence—re-ordered Preferred Unit Steam Generators. Why? . . . because they knew *from their own experience* that Preferred features assure them economical, trouble-free, long-life performance.

HERE ARE 7 MORE REASONS FOR REPEAT ORDERS:

★ INDUCED (PULL-THROUGH) DRAFT*
Eliminates need for costly stack . . . prevents escape of combustion gases into boiler room.

★ FULLY AUTOMATIC OPERATION
Even with No. 6 Oil.

★ PREFERRED ROTARY OIL BURNER
Built by Preferred especially for this unit.

★ FOUR-PASS GAS TRAVEL
Results in maximum heat absorption.

★ 80% MINIMUM THERMAL EFFICIENCY
Proved and guaranteed.

★ LOW MAINTENANCE
The result of over 27 years of combustion engineering experience.

★ FULL RANGE OF SIZES
From 20 to 500 H.P. and pressures up to 250 lbs.

* An example of the engineering "extras" behind Preferred's performance record is Induced (Pull-through) Draft. This distinctive feature permits air to be drawn around the outside of the refractory lining, thereby cooling the refractories and pre-heating the air. Combustion is aided . . . the life of the refractories is lengthened.

For complete details, write today for Bulletin 1000-F.

Be Sure to See The
PREFERRED UNIT STEAM GENERATOR
at the
POWER SHOW
Grand Central Palace
New York City
BOOTHS 30 & 31

Two-pass 15 lb. pressure units available in 20-30 H.P. Minimum 75% thermal efficiency.

PREFERRED UTILITIES MANUFACTURING CORP. 1860 BROADWAY, NEW YORK 23, N. Y.

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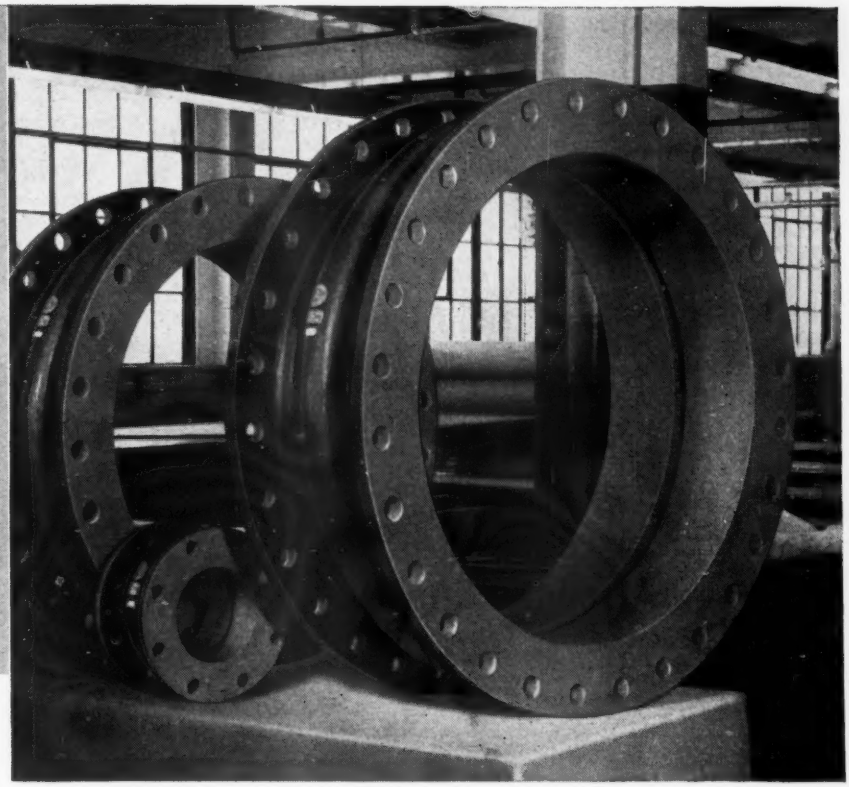
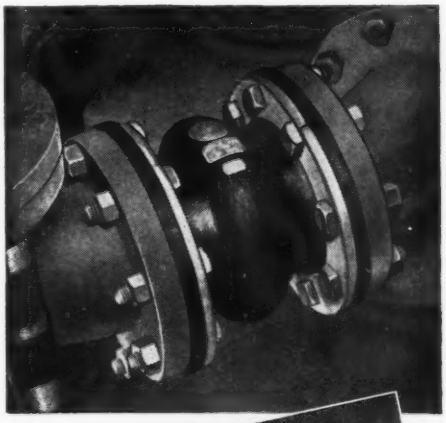
PREFERRED UTILITIES MFG. CORP.

Garlock

RUBBER EXPANSION JOINTS



for Pressure, Vacuum or Pressure and Vacuum



Garlock Rubber Expansion Joints are flexible, rubber spool-type joints for installation in pipe lines to relieve stresses and strains in the piping and equipment. They function in four ways: (1) compensate for linear expansion and contraction due to temperature changes; (2) absorb vibration; (3) eliminate or reduce noise; (4) compensate for minor misalignment in the piping.

Made of an exclusive high-grade rubber compound developed in our research laboratories, Garlock Rubber Expansion Joints are strong, efficient and long-lasting. They are easy to install. Furnished in all pipe sizes from 2" to 72"—and in three styles: No. 204 for *Pressure;* No. 205 for *Vacuum;* No. 206 for *Pressure and Vacuum.*

Garlock Rubber Expansion Joints of standard construction are suitable for handling hot or cold water, brine or exhaust steam at temperatures up to 180°F. Joints with synthetic rubber lining are recommended for service involving oils, acids or mild caustic solutions. Write for new descriptive folder.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada:
The Garlock Packing Co. of Canada Ltd., Montreal, Que.

GARLOCK

"8 Years of Constant High Temperatures

——————— *and our Rockbestos A.V.C. is Still Going Strong!"*

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"In 1940, when we revamped our boiler room, we rewired our lighting and power systems completely with Rockbestos A.V.C. wire and cable.

"The asbestos-varnished cambric insulation continues to do its job under constant high temperatures approximating 140°F.

"Where ordinary wire and cable gave us frequent trouble, Rockbestos A.V.C. gives entire satisfaction.

"Whenever we have need of wire or cable for use under extreme temperatures you can count on us specifying Rockbestos!"

This tested-in-service story is one of many which proves that you can protect your circuits by using the right wire for a tough job — specify Rockbestos A.V.C. Write for the new catalog showing all types.

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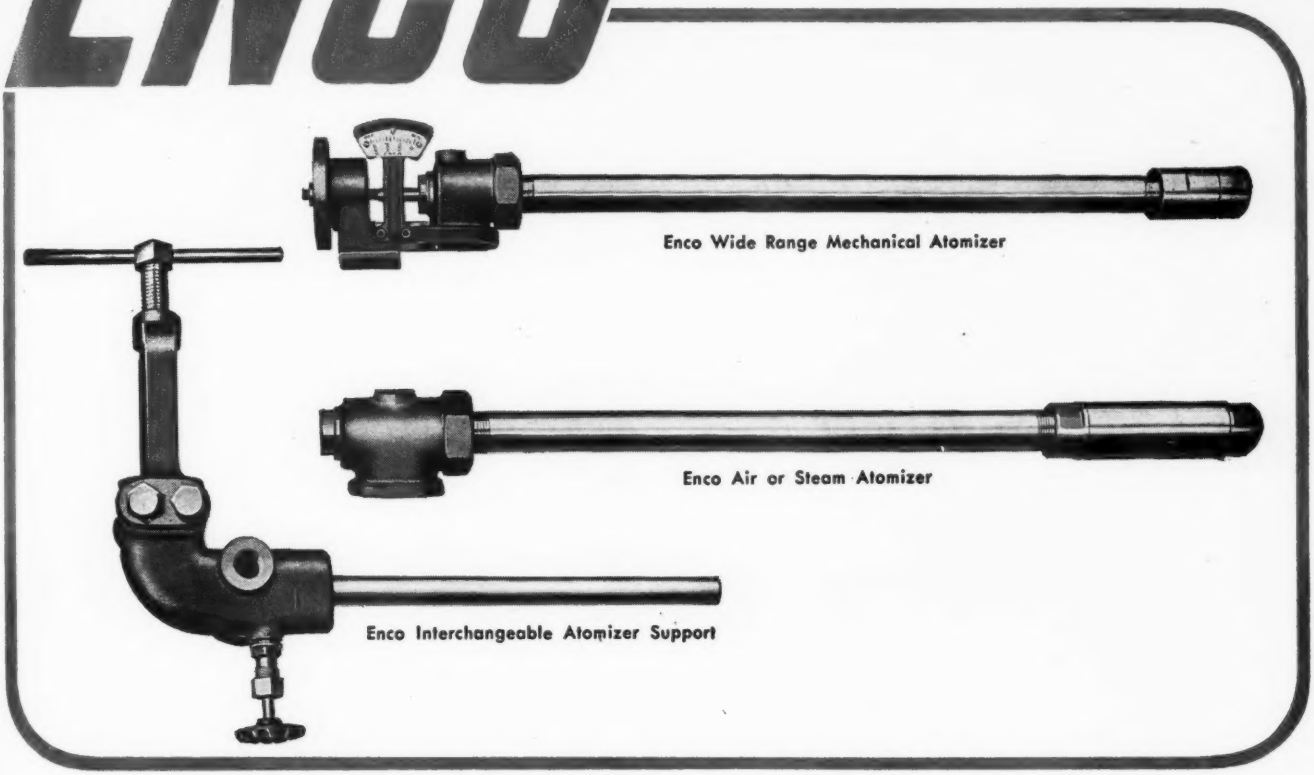
ROCKBESTOS

THE WIRE WITH PERMANENT INSULATION

For Better Combustion Practice Use

ENCO INTERCHANGEABLE ATOMIZERS



Enco Wide Range Mechanical Atomizer

Enco Air or Steam Atomizer

Enco Interchangeable Atomizer Support

Interchangeable Enco Fuel Oil Atomizers are improving combustion practice in more and more progressive boiler rooms. Designed for exceptionally wide capacity ranges with all grades of liquid fuels, they eliminate burner tip changes, through the entire load range.

1. *Wide Range Mechanical Atomizers*—With a capacity range of 10 to 1—controlled manually at atomizer or automatically from remote station—*constant high oil pressure at atomizer insures efficient atomization over entire load range without recirculating or returning oil.*
2. *Steam or Air Atomizers*—Capacity range of 10 to 1—controlled by manual or automatic pressure regulation.

Both atomizers are designed to fit the Enco Interchangeable Atomizer Support. Enco Straight Mechanical Atomizers are also available.

Enco Fuel Oil Atomizers are built to give most economical, efficient service for any type pulverized coal, gas or oil-burning air register as well as for stoker-fired and industrial type furnaces. They can also be used independently for special applications.

The Engineer Company maintains a research and planning staff to help you improve your combustion practice. Literature completely describing any Enco product will be sent on request.

EC-475

THE ENGINEER COMPANY

ALSO PRODUCES:

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Enco Fuel Oil Pumping and Heating Units
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Enco Automatic Combustion Controls
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But it takes more than "any kind of water" to produce good results in a full-size operation. Whether used for power, process or cooling, water frequently needs correction. Otherwise scale, corrosion and carryover will send efficiency down, operating costs up. Water and steam-handling equipment will have a short and unhappy life.

Your best insurance against such costly headaches is a complete, time-proved water treatment system, such as that developed out of Bird-Archer's 60-plus years of field experience in solving water treatment problems.

An informative illustrated booklet discusses these problems and their solutions. Write for your copy today. BA-131

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You'll find water treatment problems discussed in detail in this Bird-Archer Booklet. The Bird-Archer 8-point Service — all or any part of which is available to you — is fully described. For a clear picture of what an elastic and complete treatment program can accomplish in *your* plant, be sure to send for this booklet on your business letterhead.

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For Lasting

..VERTICAL WALLS
..ARCHES AND CURVED SURFACES
..HORIZONTAL WALLS

Readily Assembled and Dismantled from INSIDE the Furnace

Actual installations in hundreds of industrial, institutional and utility power plants prove that Bernitz-Nygaard Water Wall Blocks outlast cast metal types 2 to 1, 3 to 1, and more.

Here's why:

In bending, tubes are always deformed at the bend. It is impossible to machine metal blocks to provide metal-to-metal contact over the entire area of the blocks on these bends. Without metal-to-metal contact, early failure is likely.

Bernitz-Nygaard "Carbofrax"* Water Wall Blocks overcome this difficulty. "Carbofrax" has not only high heat conductivity, it has also the highest refractory properties, combined with great mechanical strength. Its destruction temperature is so high it does not depend on contact alone to stay put without maintenance.

Bernitz Water Wall Blocks are doing an outstanding job in industrial utility, and instutional power plants. Remember, all the work of assembling and dismantling these blocks is done from inside the furnace. Repairs, if ever necessary, can be made with the least possible labor. outage time, and expense.

Let us help you with your furnace problems. Write for Bulletin B-341 which describes Bernitz Water Wall Blocks and other Bernitz products.

""Carbofrax" is the registered trade mark of, and indicates manufacture by, The Carborundum Company*

OTHER PRODUCTS INCLUDE:

Bernitz furnace linings • Super blocks • Blocks for walls and arches • Bernitz air-cooled floors • Bernitz super-generator linings for water gas sets • Bernitz air-cooled spreader, stoker piers • Oil burner rings

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NYGAARD WATER WALL BLOCKS

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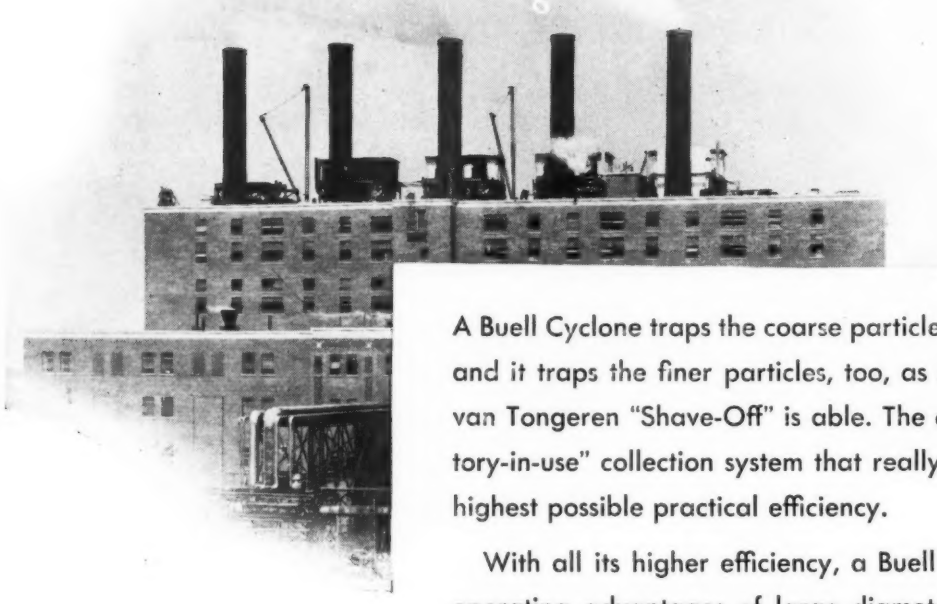
FLY-ASH COLLECTION

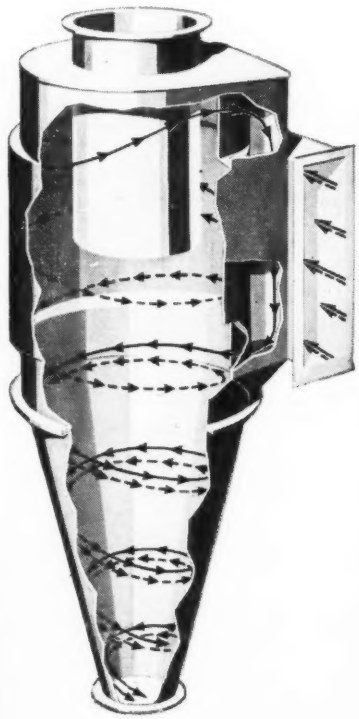
...and no regrets



A Buell Cyclone traps the coarse particles as only a cyclone can, and it traps the finer particles, too, as only a cyclone with the van Tongeren "Shave-Off" is able. The end result is a "satisfactory-in-use" collection system that really does the job—with the highest possible practical efficiency.

With all its higher efficiency, a Buell Cyclone retains all the operating advantages of large diameter: large openings that *cannot clog;* construction that reduces abrasive wear and maintenance to a practical zero; easy accessibility for inspection and repair.

Let our engineers assist in solving your fly-ash problem or in space-planning for effective collection on new boilers. For information on this service, write: Buell Engineering Company, 10 Cedar Street, Suite 5000, New York 5, N. Y.



☆ If you're at the **POWER SHOW** *SEE* how the Buell Shave-Off works.

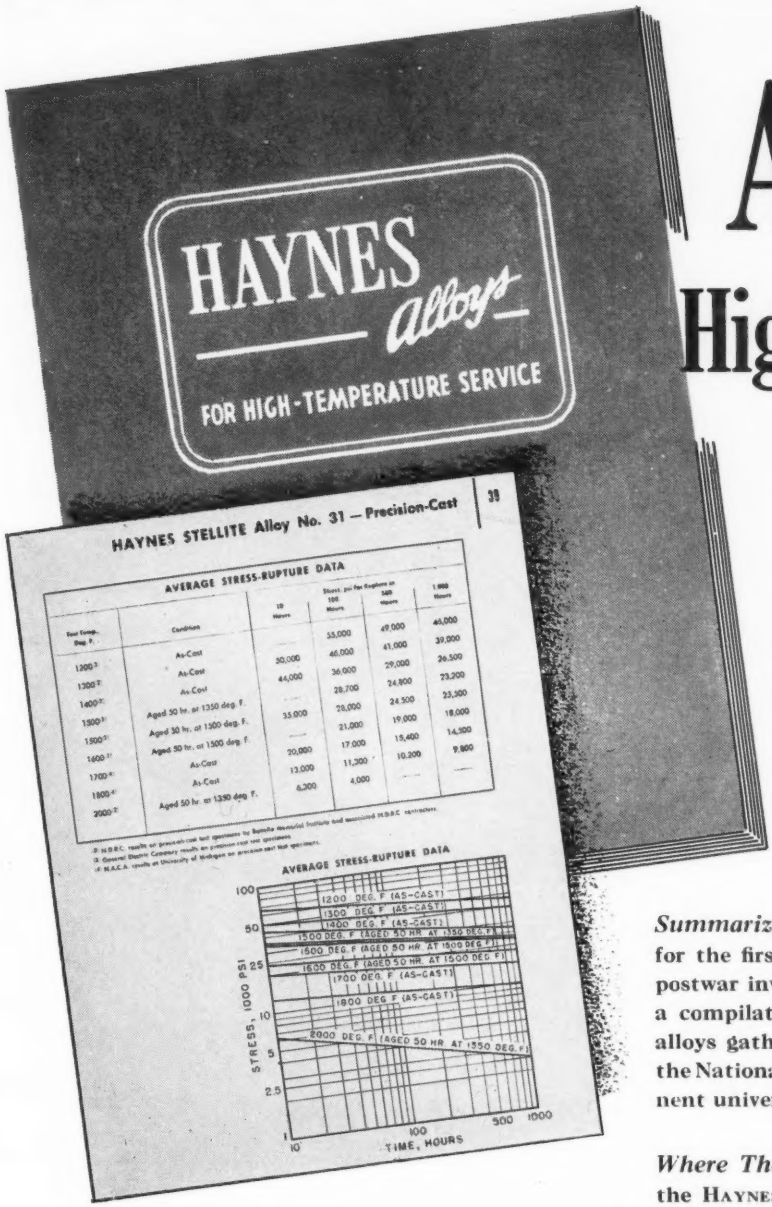
Our working model there will be *TRANSPARENT.*

BOOTH NO. 72

18th NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING GRAND CENTRAL PALACE, NEW YORK NOV. 29 TO DEC. 4, 1948

buell

Engineered Efficiency in **DUST COLLECTION**



A New Book on High-Temperature Alloys

Contains Complete Information on Physical and Mechanical Properties, Age-Hardening, and Fabricating Procedures.

Stress-rupture (above) and short-time tensile properties for each alloy are presented in tables and charts. Data on chemical composition and physical and mechanical properties are included for each of eight HAYNES alloys.

HAYNES Alloys
for High-Temperature Service
87 pages — 51 tables — 58 charts
44 photomicrographs

Summarizes Wartime and Postwar Investigations: **Here, for the first time, are summarized the many wartime and postwar investigations of the new super-alloys. This book is a compilation of data on eight HAYNES high-temperature alloys gathered by the National Defense Research Council, the National Advisory Committee for Aeronautics, and prominent university and industrial research laboratories.**

Where These Super-Alloys Are Used: **The major use for the HAYNES high-temperature alloys, until now, has been in the aircraft field. They have been used successfully in such parts as turbosuperchargers, turbine blading, rotors, cabin heaters, and exhaust stacks. Now they are also being put to use in the chemical, oil-refining, and heat-treating industries—where good high-temperature properties are likewise essential.**

Who Should Have a Copy of This Book: **Every engineer and metallurgist who designs or specifies equipment for service at elevated temperatures should have a copy of this book. Design engineers, particularly, will find it a useful guide in the selection of alloys to meet the exacting requirements of high-temperature service.**

HAYNES alloys

Haynes Stellite Company

UCC

Unit of Union Carbide and Carbon Corporation

The registered trade-marks "Haynes," "Haynes Stellite," "Hastelloy," and "Multimet" distinguish products of Haynes Stellite Company.

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Please send me, without obligation, a copy of "HAYNES Alloys for High-Temperature Service."

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Company.....

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One furnace...three fuels

SWITCH TO COAL, OIL OR GAS IN A MATTER OF MINUTES

● *Bros* engineers have achieved this remarkable new fuel flexibility by designing a steam generating unit fired by *Bros Travl-Spred* continuous ash discharge spreader stokers and combination gas and oil burners.

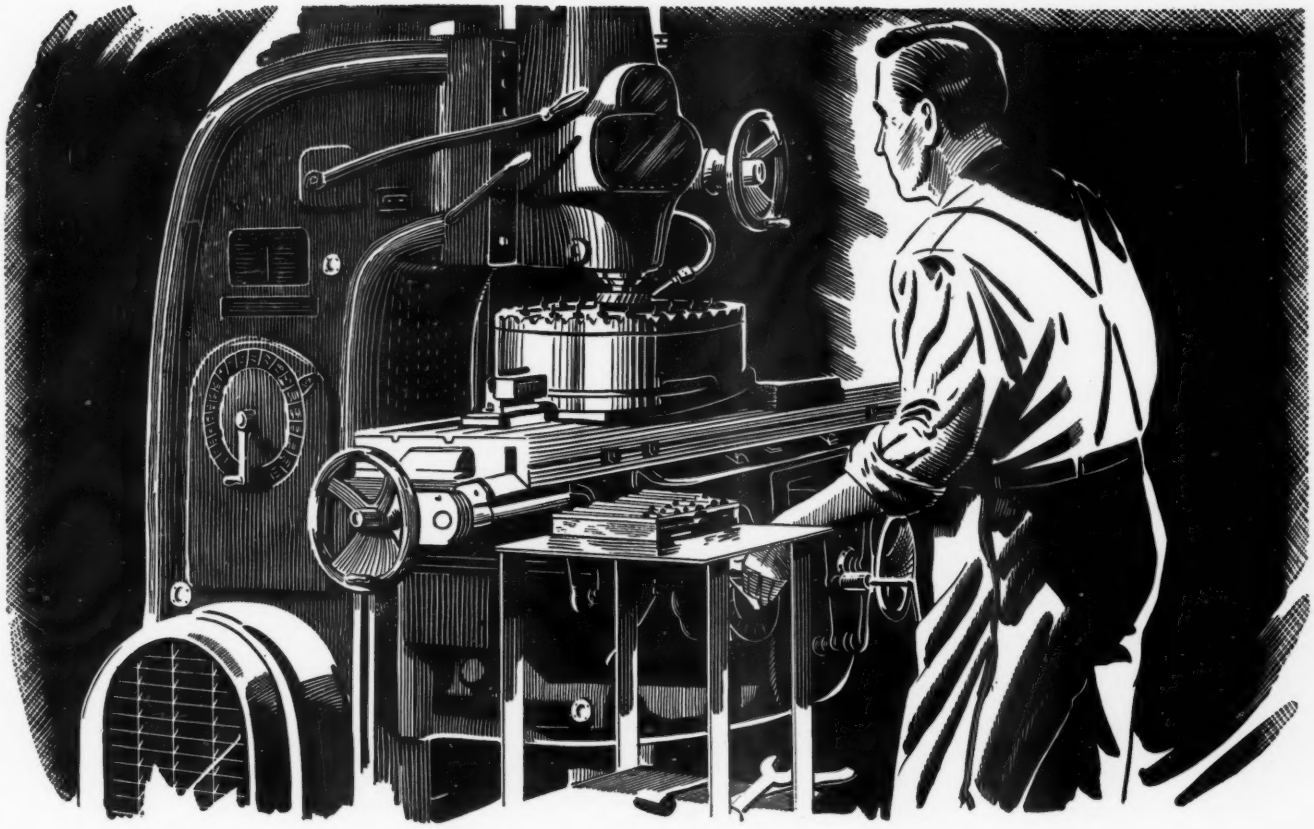
This is *Bros*' answer to today's critical problem of fuel availability. And it can free you, as a manufacturer, from the imminent threat of short supply—whether it be coal, oil or gas. For with this *one* furnace, you can use *three* fuels—and switch from one to the other easily, simply, in a matter of minutes!

In the installation pictured (B. F. Nelson Mfg. Co., Minneapolis), these two *Bros* 90,000 lb. combination units supply continuous power and process steam for the manufacture of roofing paper.

But whatever you manufacture, you can eliminate costly shut-downs due to fuel availability problems just as the B. F. Nelson Mfg. Co. has. The first step is a letter to Wm. Bros Boiler and Mfg. Co., Minneapolis, Minnesota, for complete specifications and details on this new *Bros* Combination Unit.

BROS

WATER TUBE, FIRE TUBE BOILERS • OVER FEED, UNDER FEED • HYDRAULIC-TRAVL-SPRED STOKERS



What's Interesting About UNION CHAIN'S Manufacturing?

Union Chains for Every Application

Drive and Conveying Chains and Sprockets
- Bridge Chain
- Combination Malleable Iron and Steel Chain
- HB (hardened bearing) type chain
- BP (bar and pin) type chain

★

Finished Steel Roller Chains and Sprockets
- All manufacturer's standard, size ⅜ in. to 2½ in. pitch
- Single and Multiple Strands
- Extended Pitch Series in sizes 1¼ in. to 4 in. pitch

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Silent Chain and Sprockets
- All sizes ⅜ in. to 1½ in. pitch

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Flexible Couplings
- Roller chain type
- Silent chain type

Every man, every machine, every tool and every method in our modern straight-line plant is there for only one purpose: the manufacture of steel sprocket chain and attachments for the transmission of power and the mechanical handling of materials. In view of the number of precise and complicated operations involved in the manufacture of every single pitch of steel sprocket chain, it is not surprising that our customers, both present and future, find such specialization interesting—and valuable.

The Union Chain and Manufacturing Company

TRANSMIT POWER
UNION CHAINS
CONVEY MATERIALS

Sandusky, Ohio, U.S.A.

A Cottrell Precipitator Installed by Research Corporation

WILL COLLECT OVER

95%

OF YOUR FLY ASH

A Research Corporation Cottrell will effectively clean stack gases by removing over 95% of all the different size fly ash particles suspended in the gas.

It will operate with a low draft loss, averaging only a few tenths of an inch of water across the Cottrell. The electrical power required for energizing the Cottrell is extremely low, amounting to only .5 to 1.0 KWH per 100,000 cubic feet of gas cleaned.

The *plus* efficiency of Research-installed Cottrells is assured by Research's experience gained in over 35 years and 1100 installations. This knowledge is essential to successful dust control, for every application presents its own peculiar problems. Each installation must be individually engineered.

Research-Cottrells can be installed to furnish any degree of efficiency desired, and to handle any volume of boiler gas. Full information is presented in an interesting 28-page bulletin. Write for your copy today.

Research Corporation Installations

47 CARBON BLACK PLANTS
200 METALLURGICAL INSTALLATIONS
203 ACID PLANTS • 34 PAPER MILLS
262 DETARRING INSTALLATIONS
195 POWER STATIONS
71 STEEL PLANTS • 95 OIL REFINERIES
AND MISCELLANEOUS INSTALLATIONS

RESEARCH CORPORATION

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Put pennies to work - saving DOLLARS!

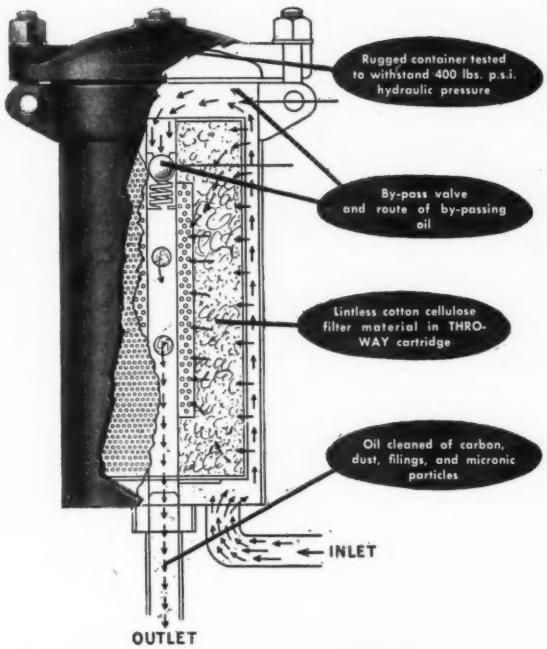
Buy genuine NUGENT Filter replacements and you buy longer filter life - - cleaner oil.

Every genuine replacement cartridge for a Nugent Filter bears the well-known "Nugent" marking, and carries with it Nugent's traditionally thorough research, engineering and careful workmanship that mean positive, dependable protection for your equipment. You *can* afford Nugent replacement cartridges—you *can't* afford less.

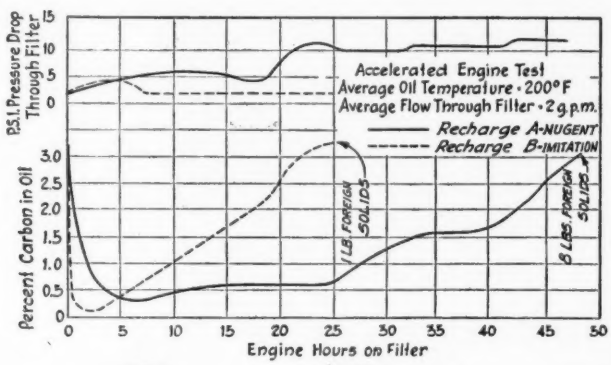
Shown above is a Nugent replacement "Throway" absorbent recharge. These recharges are designed and built to be installed as integral, close-fitting units of Nugent Filters. When these recharges are placed in the filter shell, there is no path for the moving oil (except for emergency by-passing) but through the filter element which forces the dirty oil to spread evenly into all parts of the filtering material.

(Below) Chart of a recent test comparing a Nugent Replaceable Recharge with an imitation.

The Nugent Recharge operated twice as long, absorbed 8 times the carbon, grit, etc. and provided cleaner oil.


Rugged container tested to withstand 400 lbs. p.s.i. hydraulic pressure
By-pass valve and route of by-passing oil
Lintless cotton cellulose filter material in THRO-WAY cartridge
Oil cleaned of carbon, dust, filings, and micronic particles
INLET
OUTLET

Cutaway view of a Nugent Depth-type Pressure Oil Filter.


P.S.I. Pressure Drop Through Filter
Accelerated Engine Test
Average Oil Temperature - 200° F
Average Flow Through Filter - 2 g.p.m.
Recharge A-NUGENT
Recharge B-IMITATION
Percent Carbon in Oil
1 LB. FOREIGN SOLIDS
8 LBS. FOREIGN SOLIDS
Engine Hours on Filter

Wm. W. *Nugent* & Co., Inc.

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Established 1897

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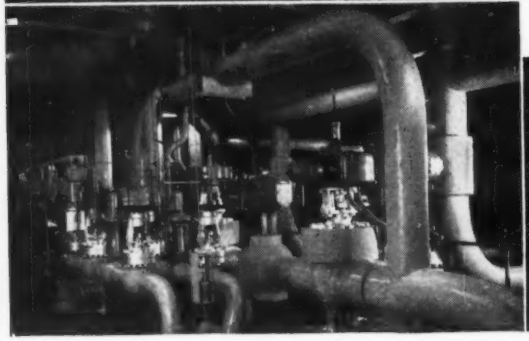
COMPLETE PIPING SYSTEMS *from Blueprint to Erection!*



Pittsburgh Piping and Equipment Company assumes complete responsibility for a high temperature, high pressure piping system . . . beginning with the blueprint and ending only when the system is installed. By placing this responsibility in the hands of a specialist you obtain the advantages of a distinctive engineering technique, specialized manufacturing facilities, broad experience in diversified piping applications, and skill in meeting and solving present-day erection problems. You are relieved of the thousand-and-one details that are part of today's fabricating and erecting problems—and assured of a lastingly reliable and efficient piping system. Consult our nearest representative for further particulars.

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Public Square Building, Cleveland
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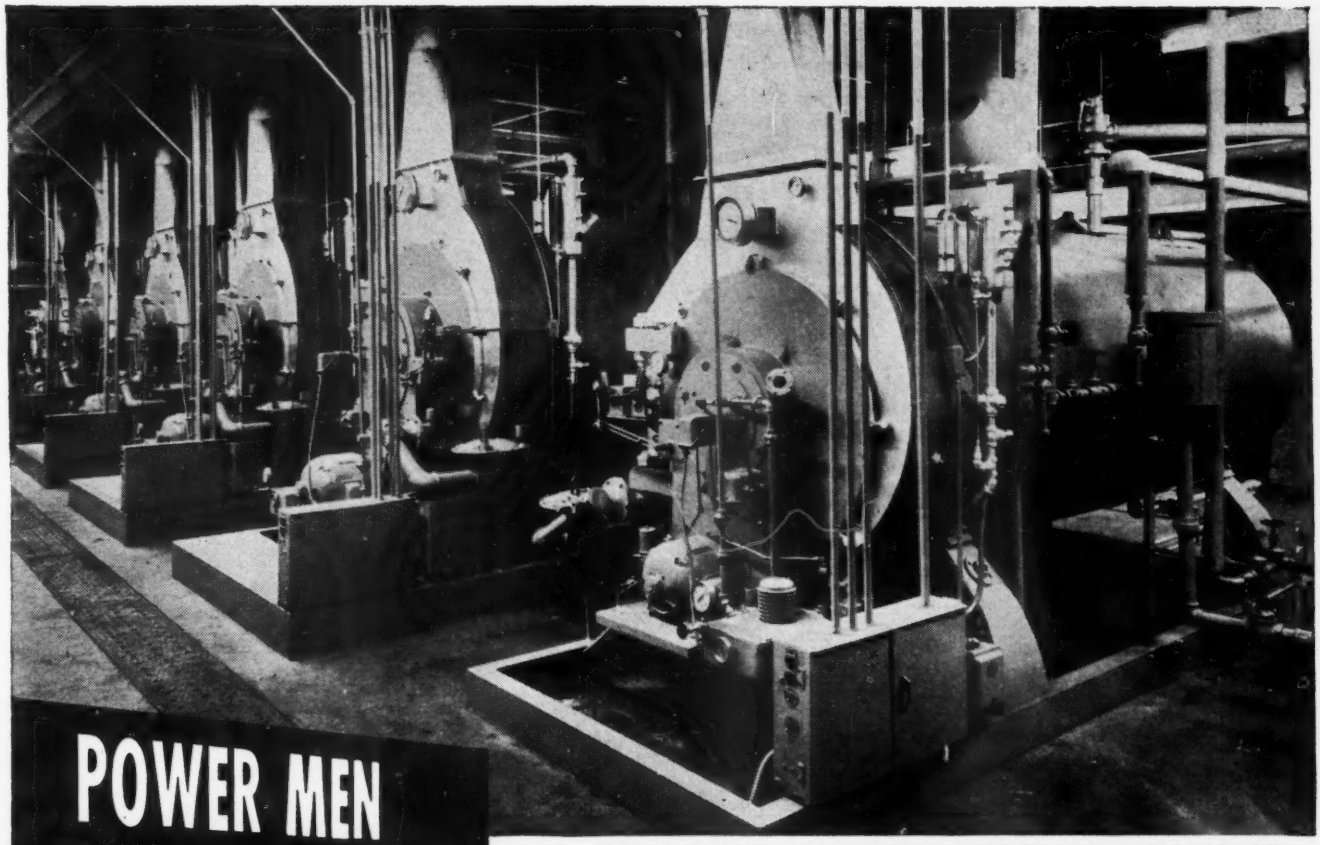
Heights State Bank Bldg., Houston
Whitehead Building, Atlanta



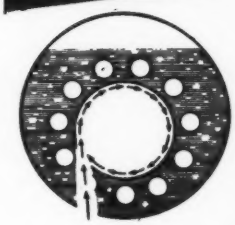
Cyclotherm Multiple Unit installation consisting of one 100 H.P. unit (foreground) and five 200 H.P units Operating pressure 125 psi; interchangeable No. 6 oil and gas firing.

POWER MEN cannot overlook this trend...

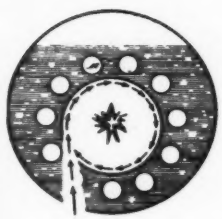
RESULTS PRODUCED by the many Cyclotherm Multiple Unit Installations prove the soundness of this type of system used for large steam requirements. On one typical installation, a battery of eight 200 H.P. Cyclotherm Steam Generators has saved $12,000 a year in fuel alone Maintenance and operational costs have been reduced 75%!

Operated by a unique Inter-related Battery Control, Cyclotherm Multiple Units quickly and automatically adjust to fluctuating steam demands. The individual steam generators are cut "on" or "off"—or modulated over a wide range to match existing steam demand with the most efficient generating capacity In this way, Cyclotherm provides high efficiency despite fluctuating loads—whether operating full or at a small fraction of total capacity.

Cyclotherm Steam Generators are available in sizes from 10 to 300 H.P with oil, gas or interchangeable firing—as single units or as multiple installations All Cyclotherms incorporate the exclusive Cyclonic Combustion principle—fully described in Bulletin P-1. Write for your copy today

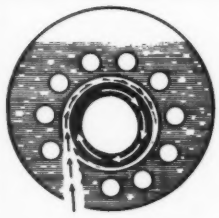


High velocity air is continuously injected at a tangent forming a swirling tube of air This tube of air both supports combustion and protects the metal against direct flame impingement



High voltage ignition is provided, followed at a timed interval by the introduction of fuel through a nozzle in the burner head.

The atomized fuel is ignited and immediately drawn into the cyclone of air which mixes with the fuel and forms a swirling tube of flame that extends the entire length of the chamber



The full-length swirling flame is separated from the chamber wall by a thin layer of air

This concentrated proximity of the flame provides heat transfer unequalled by any other method of combustion

SEE CYCLOTHERM AT BOOTH 15C
18TH NATIONAL POWER SHOW

"Cyclotherm"—the registered trade-mark of products of Cyclotherm Corporation.

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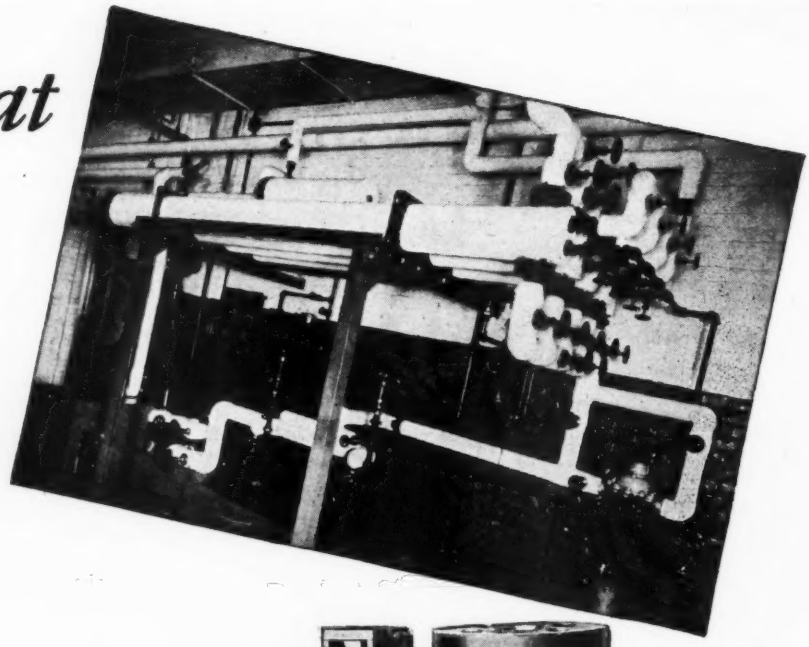
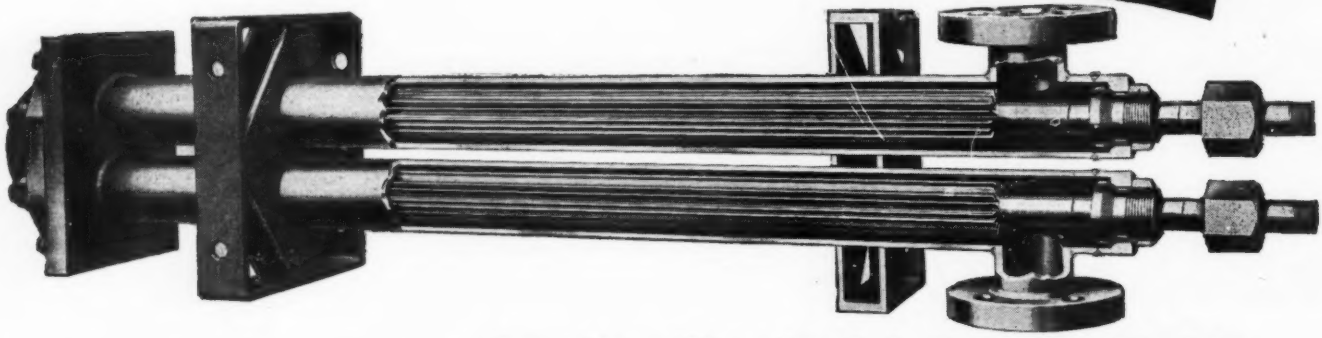
Isn't this what you want in a **FUEL OIL HEATER?**





SIMPLE — Just a pipe within a pipe—that's the principle of the Twin G-Fin Section. The G-Fin inner pipe, through which the steam passes, has longitudinal fins to provide greater surface for transfer of heat to the oil flowing through the outer pipe.

COMPACT — The longitudinal G-Fins provide at least six times as much heat transfer surface as bare tubes . . . the result: the Twin G-Fin unit has fewer tubes than any other type of heater.

LEAK PROOF — Leakage between steam and oil cannot occur because there are no internal joints.

READILY INSTALLED — The Twin G-Fin Section is easily handled, and can be placed close against a wall, ceiling or floor . . . wherever most convenient. Movable supports further assist convenient installation.

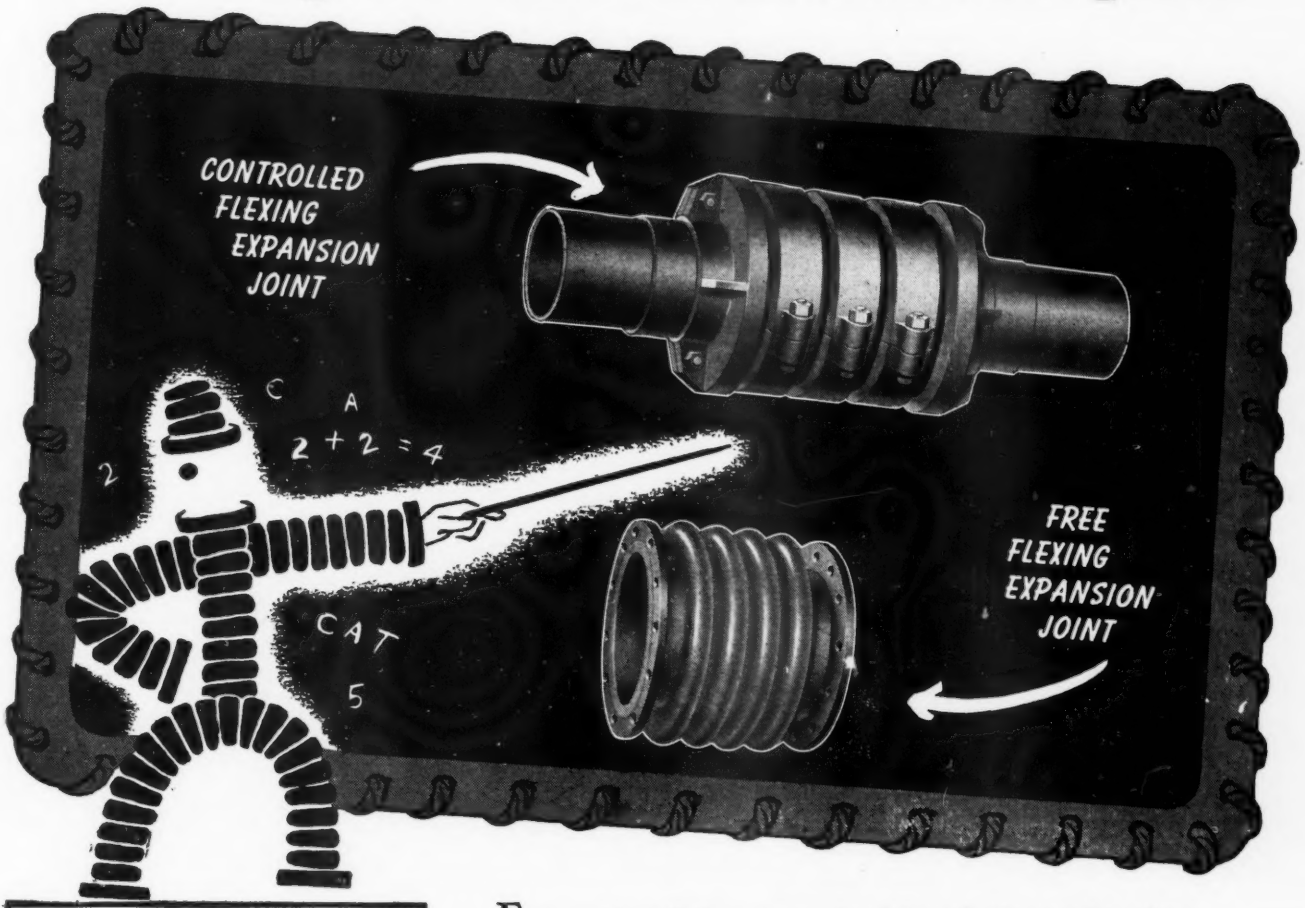
FLEXIBLE CAPACITY — These units are standard and interchangeable. They may be arranged in series or parallel; and at partial loads, sections may be cut in and out to maintain constant oil temperature.

EASY TO CLEAN — The G-Fin heating elements or pipes may be completely removed from the shells for cleaning, without disturbing the oil connections. No special tools are required.

THE GRISCOM-RUSSELL CO., 285 MADISON AVENUE, NEW YORK 17, N. Y. OR-192

GRISCOM-RUSSELL
TWIN G-FIN SECTION
The Universal Heat Exchanger

Let CMH simplify expansion control for you



CMH FREE-FLEXING EXPANSION JOINTS for pressures to 30 psi.; temperatures to 1400° F. Sizes to 24" I.D. Flanged or welding ends.

CMH CONTROLLED-FLEXING EXPANSION JOINTS with precision mated control rings for pressures to 300 psi.; temperatures to 1400° F. Sizes to 24" I.D. Flanged or welding ends.

SPECIAL CMH EXPANSION JOINTS for higher pressures can be furnished. Recommendations will be made on receipt of installation details.

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"the science of FLEXONICS . . ."the controlled bending of thin metals for use under varying conditions of temperature, pressure, vibration and corrosion"... is exemplified in the basic products of Chicago Metal Hose Corporation.

The charts mentioned above plus additional application data are presented in Bulletin EJ-47A. Write for copy.

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Expansion Joint Division • Maywood, Illinois

Plants at Maywood, Elgin and Rock Falls, Illinois

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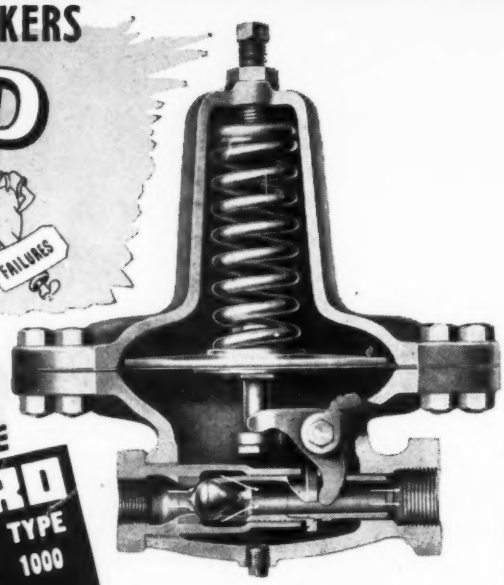

FROM PLANTS EQUIPPED WITH THE CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVE

. . . USER STATEMENTS THAT FOLLOW . . . TELL WHY

A MANUFACTURER OF RUBBER PRODUCTS SAYS-

"It is very easy for us to check every one of the 10 points because of the fact that the CASH STANDARD Type '1000' Streamliner which we purchased from your company replaced an old style hand operated valve which took constant manual attention to guarantee accurate pressure results. We do not hesitate for a minute to compliment you on manufacturing an excellent product and, as our needs increase, so will our use of CASH STANDARD Streamlined Valves."

ANOTHER MANUFACTURER IN CHECKING OUR 10 POINTS SAYS —

"The CASH STANDARD Valve is one of the finest pieces of equipment in use in our new plant. CASH STANDARD valves are not new to us; for over 38 years they have played a leading part in our production."

A MANUFACTURER OF MACHINES CHECKS ALL OF THE 10 POINTS AND SAYS—

"We use these '1000' valves in the smaller sizes on compressed air lines. They are indeed a pleasant surprise and I check fully with your 10 points. I have no intention of switching to another design."

WE CHECK WITH EVERY ONE OF THE 10 POINTS WRITES A MANUFACTURER FROM ONTARIO

"We do not have many of these valves at present but our maintenance department has asked that they be used wherever possible in replacements. It is claimed that they are not only very simple in their construction, but that they take up so little room. After reading your list of questions it was suggested that we check every one of them."

- ✓ 1. **Maximum capacity when needed most.**
- ✓ 2. **Accurate pressure control under toughest working conditions.**
- ✓ 3. **Trouble-free service.**
- ✓ 4. **Smooth operation.**
- ✓ 5. **Tight closure.**
- ✓ 6. **Speedier production results.**
- ✓ 7. **Elimination of failures.**
- ✓ 8. **Cost-saving operation.**
- ✓ 9. **No spoilage.**
- ✓ 10. **Practically zero in maintenance.**

Send **FOR BULLETIN 962**

CASH STANDARD CONTROLS . . . VALVES

A. W. CASH COMPANY
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BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES

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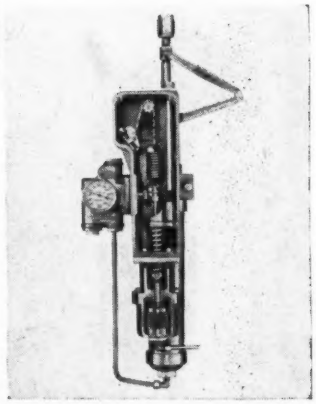
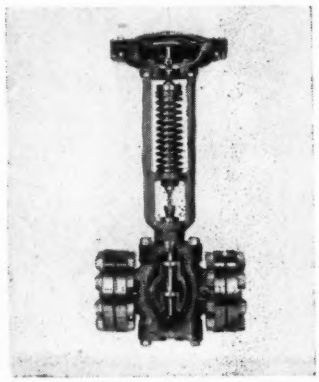
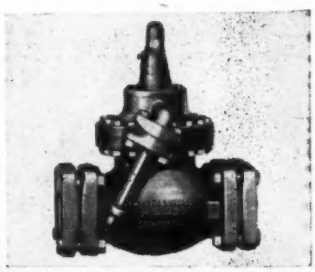


Bulletin 963 features the CASH STANDARD Type 100 Series of Super-Sensitive Controllers — various types for automatically operating valves, dampers, rheostats, stokers, pulverizers, fans, and other apparatus. 16 pages filled with descriptions and applications.

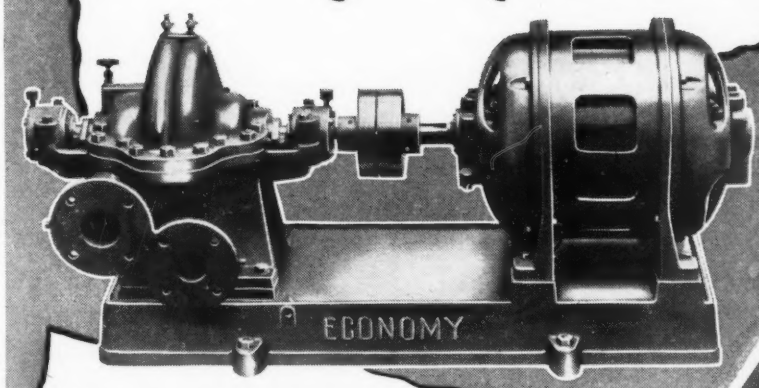


Bulletin 968 features the CASH STANDARD Type 34 Pressure Reducing Valve — direct operated — direct acting for handling steam, hot water, cold water, air, oil, brine—and most liquids and gases except some injurious chemicals. Illustrates and describes the different styles available and tells about their applications. Three pages of capacity charts.



Bulletin 956 features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.

What does a "down" pump cost...



In a recent, authoritative survey covering 15 industries, a number of plants reported that the average "down time" for a pump was 13 hours, while the average cost of a pump failure was $615.00. Check into the latest pump failure in your plant . . . see what it cost you in lost production and labor. For mechanical dependability, coupled with pumping efficiency, investigate ECONOMY Type DMD, Two Stage Pumps for clear water service with pressures and capacities in the range of 175 to 400 feet head, at 70 to 700 G.P.M. Bulletin C-746 gives complete data. Write Dept. BC-12 for your copy today.

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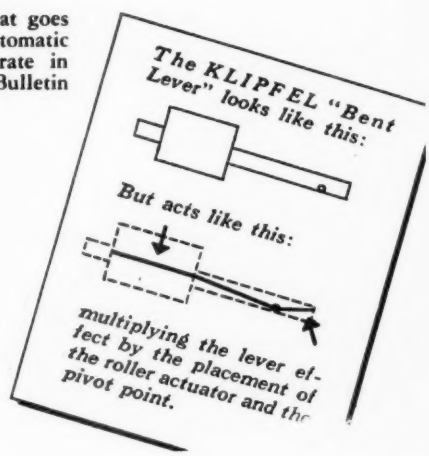
These features are a sample of the engineering that goes to make KLIPFEL Reducing Valves and other automatic regulating valves more dependable — more accurate in regulation. Write Dept. BC-12 for your copy of Bulletin 146, which describes Klipfel Reducing Valves.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multiplying the lever effect by the placement of the roller actuator and the pivot point.

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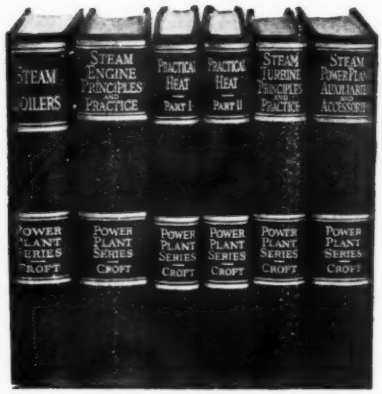
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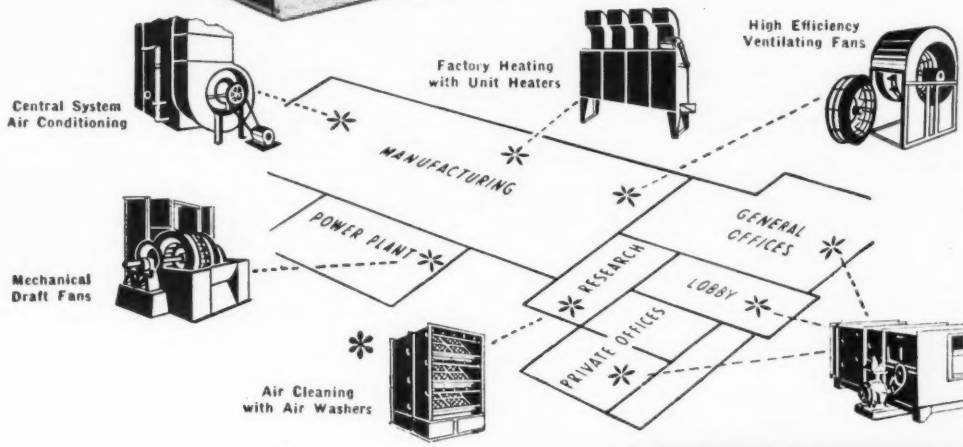

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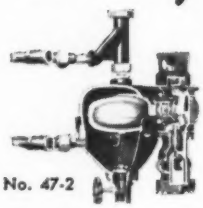

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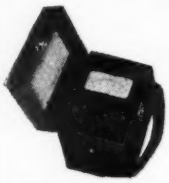

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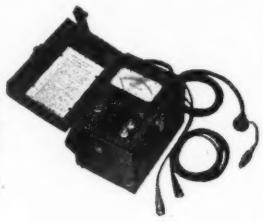

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Corrosion Problems at the United Illuminating Co.

Destructive Effect of Pollution from Industrial Wastes and Sewage

Extremely corrosive water conditions have created a difficult corrosion problem for the English station of The United Illuminating Co. at New Haven, Conn.

The English station is located on an island near the mouth of Mill River which empties into the New Haven Harbor. In warm weather the decomposition of organic matter generates hydrogen sulphide and other gases which rise to the surface of the water. River traffic also disturbs the fine sediment or mud which eventually finds its way into the condensers.

Until 1939 Admiralty tubes in their surface condensers gave a satisfactory performance and averaged about 10 years. This condition changed suddenly soon after the 1938 hurricane, which lashed the Connecticut shore line, and washed large quantities of organic matter into Mill River. This marked the beginning of a period of severe corrosion which affected all equipment handling this water. Within a year several of their condensers had to be retubed.

25,000 square foot Worthington Surface Condenser at English Station. Courtesy: The United Illuminating Co., New Haven, Conn.

Inhibited Admiralty tubes were installed since no time was available for experimentation with different alloys. Within six months a large number of tube failures developed. Severe corrosion pitting penetrated the tube wall. A condenser was retubed with plain Admiralty which also soon failed in the same manner.

In the meantime, test lots of various alloys such as plain Admiralty, inhibited Admiralty, Aluminum Brass, Aluminum Bronze and 70-30 Cupro Nickel were installed and examined at frequent intervals. At this time Aluminum Bronze looked very promising. A condenser was then equipped with Aluminum Bronze tubes. Within three years some of these tubes failed from corrosion fatigue cracking and from excessive pitting. Because of restrictions in copper products, the company was not able to purchase additional Aluminum Bronze at this time and therefore installed Aluminum Brass in another condenser. Failures within two weeks were traced to those tubes which were located in the path of the incoming steam which enters the condenser at high velocity. Excessive vibration had occurred which led to the failure. Abrasion marks present on the surface indicated that the vibration had been severe enough to cause the tubes to strike each other. The severest pitting occurred midway between the tube sheets and tube supports.

Excessive vibration was reduced in one condenser by installing two additional tube supports, making four instead of two. In other condensers wood strips and flattened condenser tubes were wedged between the tubes located in the path of the incoming steam in order to dampen the vibration.

Improving Water Conditions

In the meantime a serious effort was made to correct the bad water conditions. The river was dredged. Paper mills above and opposite the plant took steps to reduce the waste discharged into the river. Water conditions were greatly improved by these measures. Treatment of the condensing water by hypochlorite was found to greatly reduce the amount of slime in the water passes.

Aluminum brass alloy tubes have been in use since 1944 and their performance indicates that the improvement in water conditions and reduction of vibration have materially increased the life of their condenser tubes.

Tube failures have dropped considerably from the peak encountered in 1942.

The present day outlook is to use the best available alloys regardless of first cost, since the best is the cheapest in the end when based upon long service life and the minimum of interruptions.

Contact the nearest Bridgeport office regarding your condenser tube requirements. Write for Bridgeport's 120-page Condenser Tube Manual which contains a wealth of technical information on available alloys and their applications.

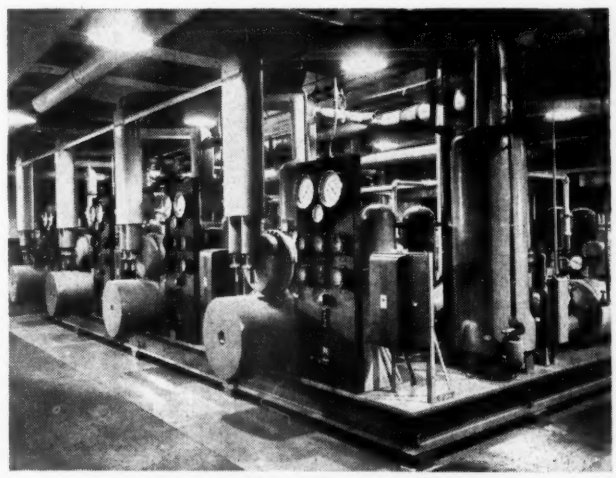
A Quick Look at the Heat Pump

The beautiful office building of United Illuminating Company at New Haven is modern to the nth degree. It is comfortably heated in the winter and pleasantly air cooled in the summer by a giant heat pump located in the basement.

Will the heat pump be used for heating and air conditioning our homes and office buildings of the future? Briefly, the heat pump is a refrigeration unit operated to make use of heat instead of cold. Heat is removed from well water, the earth or even outside air, stepped up in temperature then used to heat the building or home. The significant fact is that the heat pump produces three units of heat, sometimes more, for each unit of electricity (kilowatt-hour) it uses.

The heat pump at United Illuminating uses well water with a year round temperature of about 58° F. Extraction of heat from the water during winter lowers its temperature to about 40° F. Heat put into the water during the summer (when cooling the building) raises its temperature to about 70° F. Cold water circulated through the building during summer varies from 58° F. to 40° F., while circulating hot water during winter starts out at temperatures up to 125° F. Since this is not as high as most hot water heating systems, larger radiators are required, with fans to blow air over them.

The amount of electricity used for heating and cooling the entire building during 1947 was less than sixty-five percent of that used for lighting the building during the same period. Coefficient of Performance, taking into account all power for accessories, including ventilating fans and pumps averaged about 2.9.



Heat pump at The United Illuminating Company.

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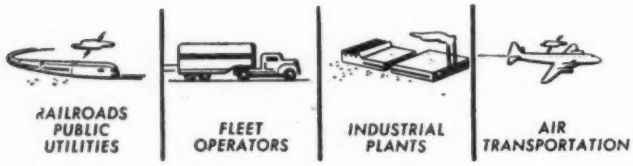

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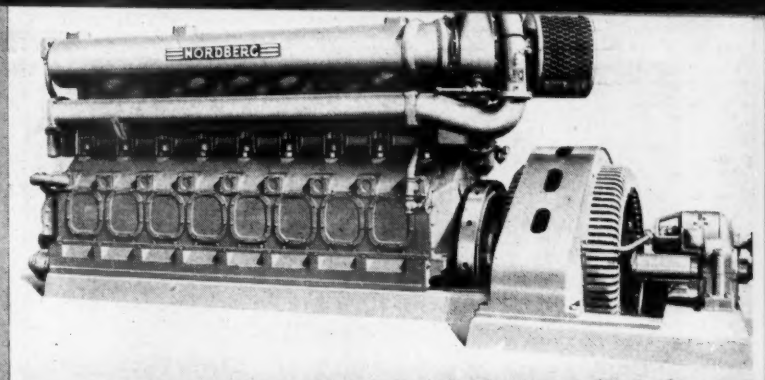
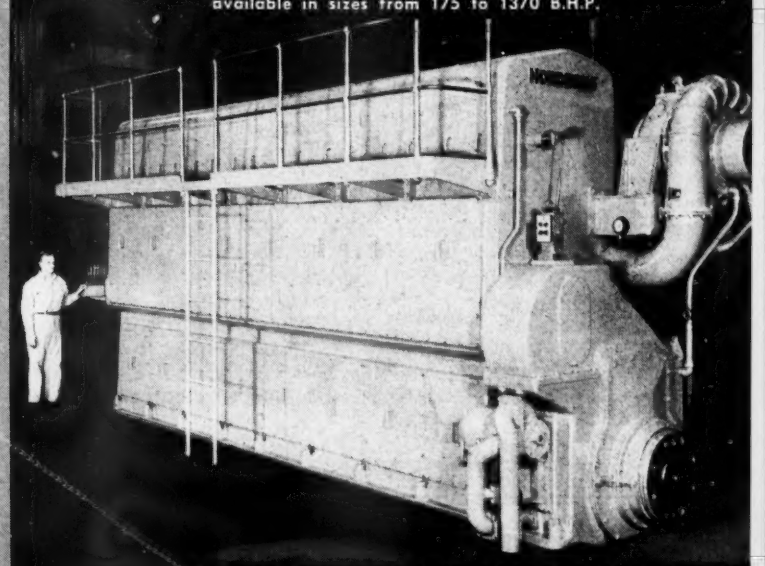
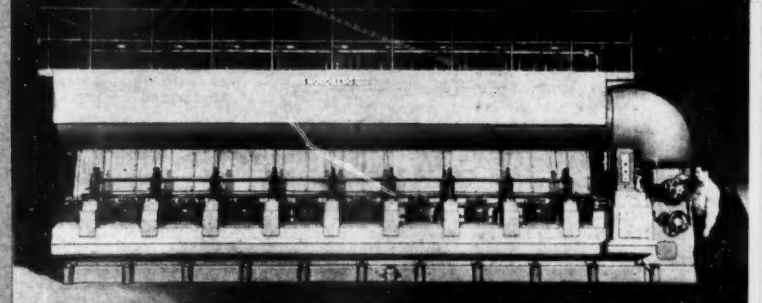


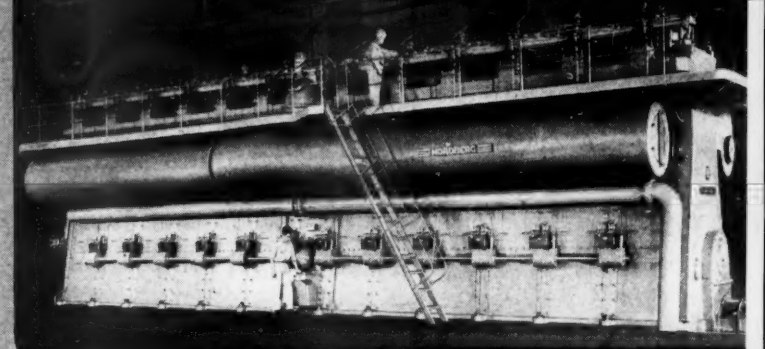
Nordberg FS-138-SC 4-cycle Supercharged Diesel generating unit. This type available in sizes from 175 to 1370 B.H.P.



Nordberg FS-168 4-cycle Supercharged Diesel engine available in sizes from 730 to 1750 B.H.P.



Two-cycle Nordberg Diesels of this type are built in two cylinder sizes with horsepower range from 1250 to 4000.



This 12-cylinder, 2-cycle Nordberg Diesel is one of the large TS-29 series available in sizes from 3570 to 8650 B.H.P.

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HAND FIRED COAL

FIGURE 1

OIL OR GAS FIRED

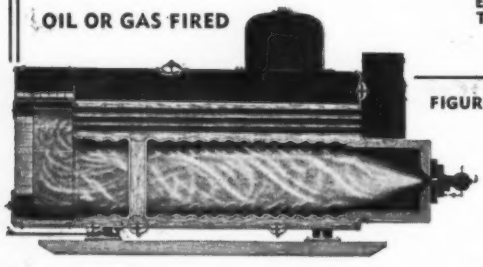

FIGURE 2

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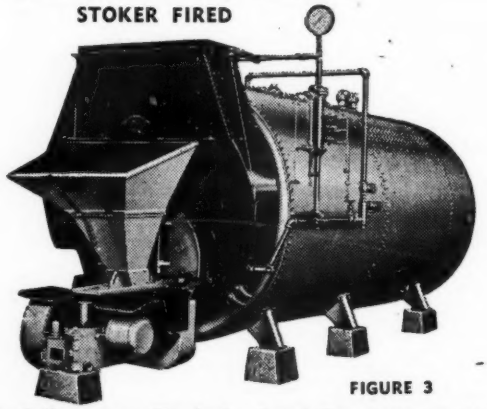

FIGURE 3

AVAILABLE IN SIZES 6 HP. TO 250 HP. THESE ARE NORMAL STANDARD COMMERCIAL (NOT INFLATED) RATINGS—AND THESE BOILERS ARE GENEROUSLY designed for OVERLOAD capacity. Built with PLUS qualities exceeding ASME and State Boiler Code Requirements.

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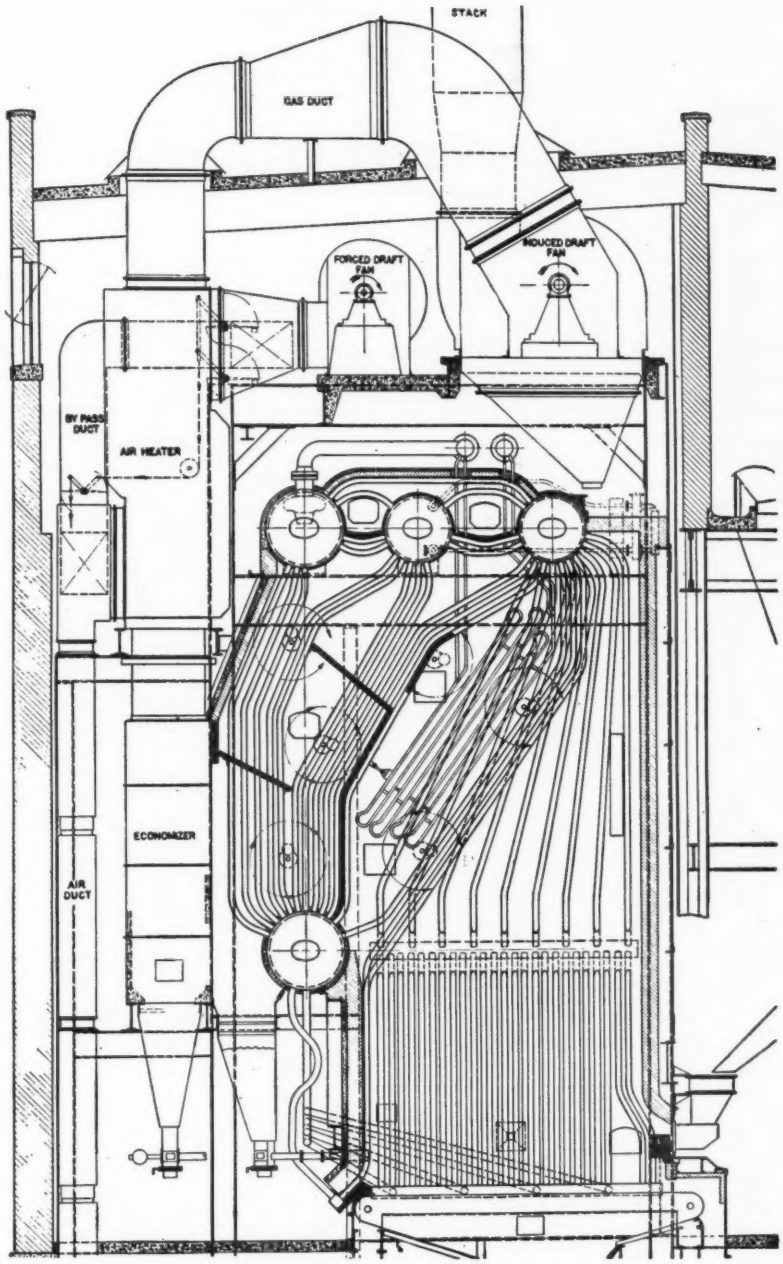

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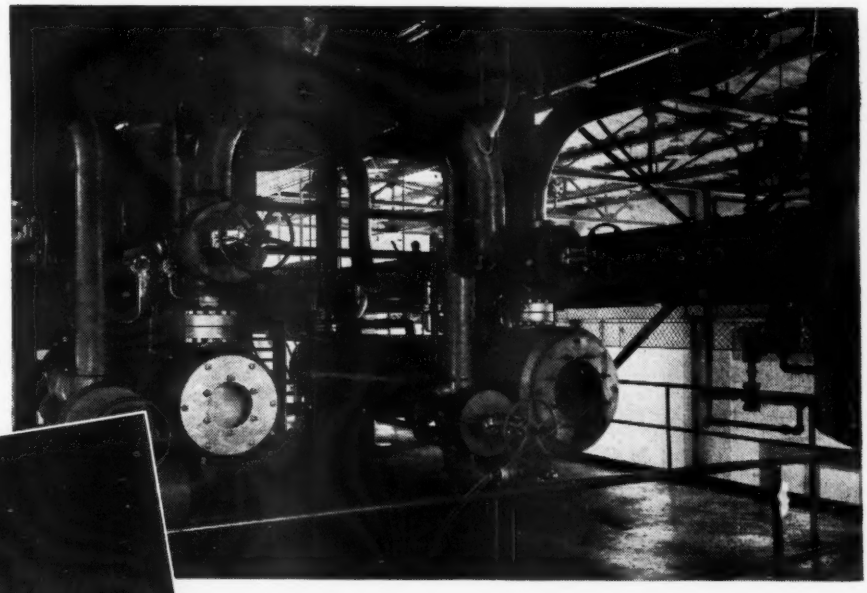

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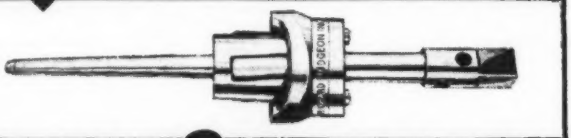

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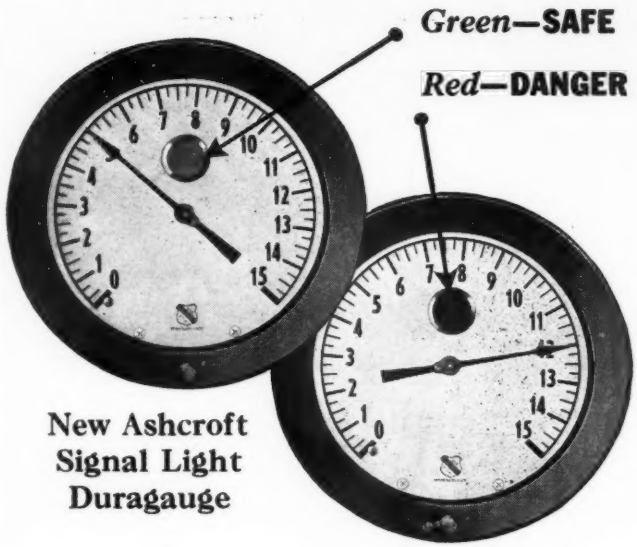

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AIR CONDITIONING EQUIPMENT
51, 95

BOILERS
15, 16, 23, 27, 37, 49, 50, 51, 54, 56, 57, 58, 65, 69, 77, 79, 86, 85, 90A, 97

CIRCUIT BREAKERS, AIR
47

CIRCUIT BREAKERS, OIL
16

COMPENSATORS
1, 39, 94

COMPRESSORS—AIR
3, 6, 30, 37, 39, 40, 45, 47, 52, 56, 62, 73, 86

CONDENSORS, SYNCHRONOUS
9, 59, 78

CONDENSORS, STEAM
8, 9, 69, 77, 85, 88, 91, 96

CONVERTORS, Synchronous-Rotary
9, 16, 30, 39, 61, 85

CRANES, TRAVELING & HOISTS
1, 30, 48, 50, 62, 67, 69, 91

DERRICKS
94

DISTILLING PLANTS
69

DISTRIBUTION LINE EQUIPMENT
91

DYNAMOMETERS
9

ELEVATORS, BUCKET
51

EJECTORS
96

ENGINES
76

Diesel
2, 8, 69, 71, 91

Steam
25, 99

FANS AND BLOWERS
30, 51, 52, 86

FREQUENCY CHANGERS
9, 16, 30, 39, 79

FUEL PREPARATION TANKS
58, 88

FURNACES
9, 97

GENERATORS

Alternating
25, 47, 52, 62, 69, 73, 76, 91, 92

Direct Current
9, 25, 30, 45, 62, 67, 73, 92

Plating
1, 52

GENERATOR SETS

Diesel
21, 11, 13, 16, 26, 28, 29, 30, 31, 41, 48, 51, 53, 57, 66, 69, 73, 75, 77, 81, 85, 90A, 91

Gas Engine
8, 25, 26, 30, 37, 50, 52, 58, 59, 73, 93

Motor
1, 9, 14, 16, 20, 30, 34, 39, 47, 52, 57, 58, 59, 61, 62, 67, 76, 85, 91, 92, 94

Steam
8, 16, 17, 43, 52, 54, 57, 58, 77, 79, 83, 91

Turbine
8, 9, 16, 30, 37, 42, 47, 50, 52, 54, 57, 58, 59, 69, 70, 73, 77, 79, 81, 85, 88, 90A, 91, 96, 97

HEAT TREATING MACHINES
69

LOCOMOTIVES, DIESEL
51

INSTRUMENTS
6, 96, 97

MOTORS
69, 73

Alternating Current
1, 9, 10, 12, 14, 16, 20, 25, 30, 34, 39, 45, 47, 50, 51, 52, 57, 60, 62, 67, 73, 76, 80, 87, 91, 92, 96

Direct Current
1, 9, 10, 14, 16, 20, 30, 32, 34, 39, 45, 47, 52, 55, 60, 62, 67, 73, 92

MOTOR STARTERS
14, 38

PIPE
8, 96

POWER EQUIPMENT, GENERAL
8, 10, 21, 31, 33, 60, 72, 73, 74, 82, 98

POWER PLANTS
24, 79

PUMPS

Pressure
19, 44, 51, 69, 76, 86, 91, 94, 96, 97

Vacuum
8, 39, 69, 76, 86

PURIFIERS, GAS
51

RECTIFIERS
9

REGULATORS, VOLTAGE
16, 36

SPEED REDUCERS
14, 51, 94

STARTERS
1, 14, 30, 62

STOKERS
96, 97

SWITCHBOARDS AND EQUIPMENT
25, 46, 96, 97

SWITCHES
12

TANKS AND TOWERS
27, 84

TRANSFORMERS
4, 5, 7, 9, 12, 16, 30, 33, 35, 39, 47, 51, 52, 59, 62, 77, 79, 85, 49, 94, 97

TURBINES

Steam
8, 64, 69

VALVES
97

WELDING EQUIPMENT
51, 94

WINCHES
89

WIRE AND CABLE
96

Alphabetical Index to Advertisers

The number preceding an advertiser's name is used in the Directory to identify this advertiser under each classification in which he is offering equipment.

ADVERTISERS No.	Name	PAGE No.
1	A-C Supply Co.	326
2	Aljohn Diesel Co., Inc.	332, 339
3	American Air Compressor Corp.	335
4	Archer & Baldwin, Inc.	330
5	Arrow Transformer Co.	334
6	Atlantic Electric Meter Corp.	335
7	Atlantic Transformer Co.	338
8	Beeson Engineering Co.	325, 337
9	Belyea Co., Inc.	310, 311, 330
10	Berger Bros. Electric Motors, Inc.	340
11	Berkwit & Co., J. C.	338
12	Bloedel, Stewart & Welsh, Ltd.	338
13	Bolinders Company, Inc.	339
14	Boswick Electric Co., The	339
15	Breerley, H. P.	334
16	Brew-Woltman & Co., Inc.	332
17	Brown, Hugh A.	344
19	C & S Machinery	340
20	Chicago Electric Co.	332
21	Chiswick Electric Motor Co.	341
23	Colbert, N. R.	342
24	Consolidated Cement Corp.	338
25	Consolidated Products Corp.	334
26	Cusac & Associated Inc., F. L.	327
27	Darien Corp.	330, 340
28	Denny & Clark	343
29	Diesel Motors Corp.	342
30	Duquesne Electric & Mfg. Co.	323
31	Ebasco Services, Inc.	342
32	Electric Apparatus & Repair Co.	335
33	Electric Equipment Co.	341
34	Electric Generator & Motor Co.	329
35	Electric Service Co., Inc.	329
36	Elk River Municipal Utilities	342
37	Ellis Co., A. Lee	324
38	Empire Electric Co.	336
39	Erie Electric Co., Inc.	331
40	FS 5180	344
41	FS 6796	344
42	FS 7059	344
43	Fletcher Sales	334
44	Glazer Brothers	343
45	Glow Electric Co.	319
46	Grove City, Borough of	330
47	Hall & Co., Stephen	341
48	Hawkins & Co.	343
49	Hay & Co., F. W.	340
50	H & P Machinery Co.	336
51	Heat & Power Co., Inc.	331
52	Hemphill & Co., J. L.	308, 309
53	Hercules Elec. Machy. & Equip. Co.	339
54	Howe Brothers	336
55	Hunt, Inc., C. V.	339
56	Hunt's Sons, N. J.	336, 344
57	International Power Machy. Co.	317
58	Johnson & Assoc., Howard Blain	332
59	Keystone Power Plant Equip. Co.	334
60	Kiemle Co., Fred W.	338
61	Kirk Co., Wallace E.	329
62	Land, L. J.	316
64	Mainzer Inc., Adolf J.	340
65	Midwest Mfg. Co.	342
66	Mississippi Valley Equipment Co.	337
67	Moorhead Electrical Machinery Co.	336
69	Neu Corp., Hugo	320
70	Newman & Company, Inc.	342
71	New York Trap Rock Corp.	344
72	Northern Metal Co.	337
73	O'Brien Machinery Co.	312, 313
74	Penn Machinery Co.	332
75	Petrus Industrial Machy. Sales	342
76	Piehl Co., C. F.	340
77	Power Plant Equipment Co., Inc.	343
78	Powertron Elec. Equip. Co.	342
79	Rearick, Charles B.	344
80	Sandman Electric Co., Inc.	343
81	Schoonmaker Co., Inc., A. G.	315, 337
82	Sherb Inc., Warner J.	340
83	Spalding Laundry & Dry Cleaning Co	342
85	Stewart Co., Paul	333
86	Superior Equipment Co.	338
87	Surplus & Salvage Co., Inc.	344
88	Tampa Armature Works Inc.	341
89	Tele-Wire Supply Co.	342
90	Thompson Crushed Rock	340
90A	Thompson Co., J. Parker	329, 330, 332, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345
91	Utilities Elec. Machy. Corp.	314, 330, 335
92	Wagner Co., Arthur	321
93	Washington Electric Co., Inc.	343, 344
94	Wayne Electric & Mfg. Co.	344
95	Weaver & Co., Charles	318
96	Wellington, Village of, Ohio	328
97	Wilson Co. H. M.	333
98	Wurth Electric Motor Co.	332
99	Zinsser & Co., Inc.	343

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3—	333	Westgse.		2400	240/480
3—	300	Pittsburg		2300	115/230
3—	300	G.E.	H	2300	115/230
	300	Pittsburg		7800	440
3—	250	Westgse.		2400	240/480
				Sec.	Inerteen
	205	Westghse. 2 Ph.		2300 3 Ph.	4150
	200	Pittsburg		4000	110/220
3—	150	Westgse.	SK	2400	240/480 Scott
1—	150	G.E.	KS	2300	115/230
	100	Pittsburg		1375/2750	110/220
3—	75	American		2400	220/440
3—	50	American		12800/6400	440
9—	50	G.E.	H	13750	125/216
1—	50	American 3 Ph.		4150	208
2—	25	G.E.	H	11500	230/460
1—	50	G.E.	HS	2400	120/240
2—	37½	G.E.	H	2400	120/240
1—	25	Mahoney		230/460	115/230
1—	15	G.E.	H	230/460	115/230

TRANSFORMERS AIR-COOLED

Qu.	Kva.	Make	Pri. Volts	Sec. Volts
2—	100	Newark	440 2 Ph.	to 220 3 Ph.
1—	75	Newark	440 2 Ph.	to 220 3 Ph.
2—	37½	A.C.	450	120
5—	27½	G.E.	440/220	220/110
	10	Westge.	450	117
	10	Newark	460	230
4—	5	Newark	230/460	115/230
4—	5	Std.	440	220
	5	Amer.	230/460	115/230
	5	G.E.	230	115
3—	3	Kuhlman	460/230	115/230

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	Type	RPM	Volts
1—	1700	Westgse.		300	2400
	300	G.E.	ATI	600	600
	250	Westgse.		600	240
	200	E.M.		514	2400
	200	E.M.		360	600
4—	200	Westgse.		720/360	4150
	150	G.E.	ATI	600	240
3—	150	G.E.	TS	450	440
1—	150	G.E.	TS	1800	440
	70	E.M.		180	2200
	50	Westgse.		1800	220
	35	G.E.	ATI	1200	2200

SQUIRREL CAGE

HP	Make	RPM	Volts
450	Ridgeway	900	2200
125	G.E.	1775	2300
100	Westgse.	1800	440
100	Westgse.	1200	2200
75	Westgse.	1800	440
1— 75	Ideal	1200	220/440
3— 75	G.E.	1200 TEFC	220/440
60	Westgse.	900	2200
40	Westgse.	900	220
40	G.E.	900	220

SLIP RING

HP	Make	Type	RPM	Volts
1—2500	G.E.	MT	257	6600
200	G.E.	MT	720 B.B.	440
60	G.E.	MT	900	440
1— 50	G.E.	MT	1800	220
1— 50	G.E.	MT	1200	2200
2— 50	Westgse.	CW	900	220
50	G.E.	MT	600	220
40	Cont.		1200	220
40	G.E.	MT	1200	2200
40	G.E.	MT	900	220
40	G.E.	MT	900	2200
30	G.E.	M	1200	220/440

A. C. GENERATORS

	Make	RPM	Volts
2500 KVA	Westghse	720	2300 Exc.
500 KW	G.E.	3600	600 Exc.
320 KW	Allis	450	480
240 KW	G.E.	600	600 Exc.
200 KVA	Allis	3600	240 Exc.
200 KVA	Westghs.	600	240 Exc.
180 KW	Westghse.	514	550
100 KW	G.E.	600	240 Exc.
75 KW	Westghse	900	2200
6— 50 KW	Westgse.	900	220/440 Exc.
35 KW	Columbia	1200	240 Exc.
32 KVA	American	1200	120/208 Exc.
7— 25 KVA	Westgse.	900 1 ph.	120 Exc.
15 KW	Star	1800	220/449
2— 10 KVA	G.E.	1800 1 ph.	480 Exc.

SPECIAL

DIESEL ENGINE GENERATORS

3—300 KW 125/250 V D.C. DeLaVerne, Westinghouse 6 cylinder 4 cycle full diesel.

OIL CIRCUIT BREAKERS

1—3000 Amp. G.E. FK25 600 V.

1—3000 Amp. G.E. FK130 15000 V.

1—3000 Amp G.E. FK12 4500 V.

Experienced Users agree—"It's HEMPHILL

THE BELL!

IS REBUILT AND TESTED

Electrical Engineers

MOTOR GENERATOR SETS

KW	Make	RPM	Volts DC	Volts AC	Type
1—1000	G.E.	514	600	4000/2300	Syn.
1—1000	G.E.	514	275	4000/2300	Syn.
500	G.E.	900	230	2400	Syn.
500	G.E.	900	600	2400	Syn.
125	Cr. Wh.	1200	125	2200	S.C.
100	El. Mach.	1200	125	4150	Syn.
2— 75	Cr. Wh.	1200	230	440	S.C.
2— 60	Cr. Wh.	1200	230	440	S.C.
1— 50	Westgse.	900	230	220	
50	Ridgeway	1200	550	220	S.C.
2— 40	El. Mach.	1800	125	440	S.C.
35	Ideal	1200	125	220	S.C.
15	G.E.	1800	125	440	S.C.
15	Westgse.	1200	250	220	S.C.
10	Westgse.	1200	250	220	S.C.
10	Star Elec.	1800	115	440	S.C.

D. C. GENERATORS

KW	Make	RPM	Volts	
330	Elliott	1200	240/335	
75	Whse.	260	230	1 Bearing
50	Whse.	1200	115	1 Bearing
2— 30	Whse.	1400	125	
30	G.E.	1100	125	
20	G.E.	1800	50	
20	G.E.	1700	125	
15	Burke	900	115	
4— 7½	G.E.	1550	120	

TURBINES

750HP Terry Red Gear 720 Bleeder
500HP G.E. 3240 RPM Cond.
300HP Whse. 6000 RPM Cond.

D. C. MOTORS 230V.

H.P.	Make	Type	RPM
125	G.E.	RC	1700
100	G.E.	LC	625
2— 80	G.E.	CDM	1750
2— 75	CW	WP	860
75	G.E.	C	575
50	CW	CM	700
2— 35	G.E.	CD	670
35	G.E.	RC	860

D. C. MOTORS
Variable Speed 230V.

H.P.	Make	Type	RPM
75/100	CW	CMC	500/1000
40	G.E.	LC	700/1000
2—30	G.E.	CDM	16550/1850
30	G.E.	RLC	400/1200
30	Whse.	SK	500/1500
25	Whse.	SK	400/1200

TURBINE GENERATOR

KW	Make	Volt	Type
500	Whse.	2400v	Non-Cond.
300	G.E.	240v	Cond.
60	Whse.	120v DC	Cond.
30	Allis	125v DC	Non-Cond.

AIR COMPRESSOR

387 CFM—Ingersol-Rand
75 HP S.C. Motor

■

STEAM ENGINE GENERATOR

120 KW Ames Uniflow
240 Volt 3 Phase non condensing

2—5 KW Gasoline Engine Generator Sets 1800 RPM
120 Volt Single Phase

"FOR POWER"
J. L. HEMPHILL & CO.
1604 53rd STREET, NORTH BERGEN, N. J.
PHONE NEW YORK—LONGACRE 5-3227
PHONE NEW JERSEY—UNION 3-2600

Business Prediction for 1949—

BELYEA

D. C. MOTORS

HP	Make	Type	Volts	Speed
6—1500	Whse.		525	600
1—1200	Whse.		600	425
1—800/1000	Whse.		450	600/720
1—700	G.E.	MCF	600	150/525
1—650	G.E.	MPC	250	115/145
1—600	G.E.	MPC	600	600/720
1—335	Whse.	MQ	250	300/900
1—275	Whse.	QM-600-6	230	425/850
1—250	G.E.	MPC	230	400/500
1—230	Al. Ch.		230	700
1—222	Whse.	SK-153.58	230	2975
1—150	G.E.	MPC	230	250/450
1—150	Cr. Wh.	CCM	230	300/1050
1—150	G.E.		600	250/750
10—150	Cr. Wh.	83H	230	890
1—150	Cr. Wh.	CMC-65H	230	1150
2—125	G.E.	CO-1832	230	625
1—125	El. Dy.	30S	230	750/1500
1—115	Cr. Wh.	JHL	230	1200
4—101	Whse.	SK	230	485/950
1—100	Rel.	1050T	230	400/1200
1—100	Whse.	SK-182	230	300/1200
1—50/100	G.E.	CD-175	230	365/730
1—80	El. Dy.	30S	230	500/1500
1—80	Whse.	SK-180	230	450/1200
2—75	El. Dy.	25-SL	230	750/1750
3—60/75	Whse.	SK-200	115	300/700
8—75	Cr. Wh.	53-H	230	860
1—60	El. Dy.	25-S	230	525/1050
2—60	Whse.	Hoist.	230	415
1—60	Whse.	SK	230	500/1000
1—60	Whse.	SK-131	230	500/1500
1—60	El. Dy.	25S	230	750/1500
2—50	G.E.	RCA-31B	230	1700
1—50	G.E.	RC-34	230	1050
1—50	G.E.	RF-16	230	500/1500
4—50	Whse.	Hoist	230	400
1—50	Whse.	SK-153	230	690/1035
1—50	Cr. Wh.	CMC-8014	230	380/750
1—50	Cr. Wh.	CCM	230	1750
2—50	G.E.	CD-1531Z	230	1000/1750
2—50	El. Dy.	20S	230	1000/1750
1—50	G.E.	RCP-36B	600	600

2— 40 Rel. 385-T 230 400/500
These units are semi-enclosed, b. brg. motors and part of complete V-S Drive with 40 KW Ind. M.G. Set with 220/440 v. A. C. Motor: exciter and complete control equipment. M.G. and control in steel enclosure.

DYNAMOMETERS

1—300/400 HP, GE-Sprague, 1325/2500 RPM type TLC—250 Volt, Cradle type, with panels—scale missing.

1—75 HP, GE-Sprague, 500/1500 RPM type C 250 Volt, Cradle type with panels—scale missing.

6—25/30 HP, GE—825/2300 RPM—250 Volt Block test, type CD-105.

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu. KW	Make	Speed	D.C. Volts	A.C. Volts
1—1800	G.E.	600	125/250	4000
1—1500	G.E.	600	600	2300/4150
1—1500	G.E.	360	275	2200/4400
1—1250	G.E.	600	275	2300
1—1000	West.	514	250	4150
1—1000	Al. Ch.	720	450	2300
1—1000	Whse.	514	600	4150
2— 500	G.E.	720	600	2300/4150
1— 500	G.E.	720	600	4400
1— 500	G.E.	720	125	2300/4000
2— 400	G.E.	720	250	440/2300
1— 400	Whse.	1200	250	2300
1— 350	G.E.	900	125	50
1— 300	G.E.	720	550	2300/4000
1— 250	G.E.	720	275	2300/4000
2— 250	G.E.	1200	250	440
1— 175	Cr. Wh.	1200	250	440
1— 150	Cr. Wh.	1200	250	440
1— 100	G.E.	1170	125	220
1— 100	G.E.	1200	250	2300
1— 75	Cr. Wh.	1160	250	220/440
1— 75	G.E.	1180	125	2300/4000
1— 60	Cr. Wh.	1750	250	220/440
1— 50	G.E.	1145	125	220
2— 50	G.E.	1200	250	2200

ROTARY CONVERTERS

60 Cycle

KW	Make	Speed	D.C. Volts	A.C. Volts
1—2000	G.E.	514	600	2300
1—2000	G.E.	450	600	2300
1—1000	Whse.	900	600	11000
1— 750	Whse.	900	600	13200
1— 500	Whse.	900	250	2300

SPECIAL—MERCURY ARC RECTIFIERS

1—750 KW—GE—Type RHW—6 Anode 575 V., D.C. Form C with 2300 V., 60 cycle transformer and switching equipment.

FREQUENCY CHANGER SETS

1—1000 KW—GE—2 unit—3 Brg. Consisting of—1400 HP—4400 V, 3 ph. 25 cy. Motor and 1000 KW—2300 V. 2 ph. 58.3 cycle gen. with exciter (Gen. can be reconnected for 800 KW, 3 ph.)

1—320 KW—GE—2 unit—3 Brg. consisting of 600 HP—440 V., 3 ph. 60 cy., 8 pf. Syn. Motor and 400 KVA, .8 pf, type AT—3 ph, 120 cy, 720 volt AC generator with direct connected exciter.

40 YEARS OF KNOW-HOW MEANS "SUCCESSFUL OPERATION GUARANTEED" BY BELYEA

BELYEA CO. INC.

OUR REPUTATION IS YOUR PROTECTION

INVENTORY+EXPERIENCE+FACILITIES+OWNERSHIP

—Economy and Performance with RE-NU-BILT REBUILT TO N.I.S.A. STANDARDS

"Successful Operation Guaranteed"

A. C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—3500	G.E-	TS	2300	257
1—2100	G.E.	ATI	4600	510
2—2000	Whse.		2300	120
1—1000	Whse.		2300	189½
1— 900	Al. Ch.	(New)	2200	150
1— 600	Whse.	Syn.	440	369
1— 500	G.E.	ATI	480	900
2— 500	G.E.	TS	4150	600
1— 450	Whse.		2300	128.5
1— 450	Whse.		2300	1800
2— 400	G.E.	TS-9838	440	600
2— 350	G.E.	TS	2200	150
1— 325	Whse.		440	900
1— 320	G.E.	ATI	2300	600
1— 300	G.E.	ATI	440	720
1— 145	G.E.	ATI	550	720
2— 125	G.E.	ATI	440	450
1— 100	Whse.		550	600
1— 100	El. Ma.		440	600
1— 85	G.E.	TS	440	1800

SLIP RING

1—1000	Whse.	CW	2300	700
1— 900	G.E.	IM	2300	880
2— 700	Whse.	CW	2200	900
1— 500	G.E.	IP	550	505
1— 400	G.E.	IM	2200	252
3— 350	Whse.	CW	2200	900
1— 350	G.E.	MT-442Y	2200/4000	253
1— 300	Al. Ch.	3 Brg.	2300	505
1— 250	G.E.	MT-563Y	550	900
1— 250	G.E.	MT-424Y	4000	257
1— 250	G.E.	MT-559S	2200	1800
1— 135	G.E.	IM	2300	700
2— 100	G.E.	IM-16	2200	435
1— 75	Whse.	CW-761	2300	1750
1— 75	F.M.	Bv-H16B	2300	1750
1— 60	Cr. Wh.	123AQ	220	700
3— 50	Whse.	CI-638A	220	870
2— 50	Whse.	CIW-504	440	870
1— 50	Rel.	IXM	2300	880
1— 50	G.E.	MT-352	550	600

SQUIRREL CAGE

1— 250	G.E.	IK	440	600
1— 250	G.E.	KT-559	440	1800
1— 200	G.E.	IK	550	865
1— 125	Whse.	MS	440	485
1— 125 (new)	G.E.	KF-TEFC	440	1190
1— 100	G.E.	IK-Vert.	2300	450
2— 100	G.E.	KT-543	220/440	1750
1— 75	G.E.	K	2200	1200
2— 60	G.E.	K-505	440	1170
1— 60/20	Whse.	CS	220	900/450
1— 50	G.E.	KF-405S	220/440	3550
2— 50	Whse.	CS	220	870
1— 50	G.E.	KT-327	2200	1750
1— 50	Whse.	CS	440	1755

TURBO GENERATORS

See our advertisement on page 330.

SYNCHRONOUS CONDENSERS

3 ph. 60 cycle

Qu.	KVA	Make	Type	Volts	Speed
1	5140	Whse.		4150	600
1	4000	G.E.	TSC	2400/4800	900
1	3000	Whse.		2400/4800	720
1	3000	G.E.	ATI	2400/4800	720
1	1000	G.E.	ATI	2300	1200
1	500	G.E.	ATI	480	900

D. C. GENERATORS

Qu.	KW	Make	Volts	RPM	Desc.
1	1500	Whse.	600	600	
1	1000	Al. Ch.	475	720	MHC
2	1000	Whse.	475	720	
7	500	G.E.	600	720	MPC
1	500	Whse.	600	900	
1	290	G.E.	1200	120/240	CY-272
2	250	Whse.	240	1200	
1	250	G.E.	240	1200	
1	155	G.E.	250	720	MPC
1	150	G.E.	125	200	MPC
1	140	G.E.	250	720	MPC
1	140	G.E.	250	300	MPC
1	100	Delco	250	1200	
2	100	Whse.	240	250	
2	90	G.E.	60	1200	B. Brg.

WELDING MOTOR GENERATOR SETS

Qu.	KW	Make	Speed	A.C. Volts	D.C. Volts
*2	90	G.E.	1180	220/440	60
*6	70	G.E.	1180	220/440	70
1	60	Whse.	1150	220/440	60
1	48 (3U)	G.E.	1750	440	60
*1	45	G.E.	1200	220	60

*These sets are complete with cubicle type A. C. & D. C. controls mounted with the set.

TRANSFORMERS

60 cycle

Qu.	KVA	Make	Phase	Type	Voltage
2	2500(new)	G.E.	1	H-DTQ	13200x3300
3	1250	G.E.	1	H	6600x550
1	600	Al. Ch.	3	OISC	2300/4000x216
1	500	Whse.	1	OISC	34600x482
1	300	Pitts	3	OISC	4150x120/208
3	200	Whse.	1	OISC	7200x240/480
3	167	G.E.	1	H	2400x240/480
6	150(new)	Wagner	1	HEBK	8800x2300
1	150(new)	Malony	3		2200x6600
1	150(new)	Al. Ch.	3	OISC	26400/13200x 120/208
2	100	Whse.	1	OISC	2300x230/460
1	25	G.E.	1	H	22000x2200
1	25	G.E.	3	HG	6000x120/208
1	25	Whse.	1	AVR	440x110
9	15	Whse.	1	AVR	440x110

A. C. MOTORS

3 phase 25 cycle

Qu.	HP	Make	Type	Volts	Speed
1	1400	G.E.	ATI	4400	500
1	390	G.E.	ATI	6600	750
1	290	G.E.	ATI	2300	750
1	200	G.E.	IP	440	290
1	150	G.E.	IP	440	290
1	75	Al. Ch.	Sl. Rg.	440	720
3	54	G.E.	MT-353-S	220/440	715
1	35	G.E.	IK	440	715
1	25	Whse.	CS	440	725
1	15	Wagner	BP-19T	220	710
2	10	Whse.	CS	440	725
2	5	Whse.	CS	440	725
2	5	Whse.	CW-461C	440	720

GEAR REDUCTION UNITS

Qu.	HP	Make	Speeds
1	1400	Whse.	3600/514
1	943	G.E.	5306/1200
1	700	Kerr	3600/900

MAIN OFFICE AND SHOP

43 HOWELL ST., JERSEY CITY 6, N.J.

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Also N. Y. City line REctor 2-7150

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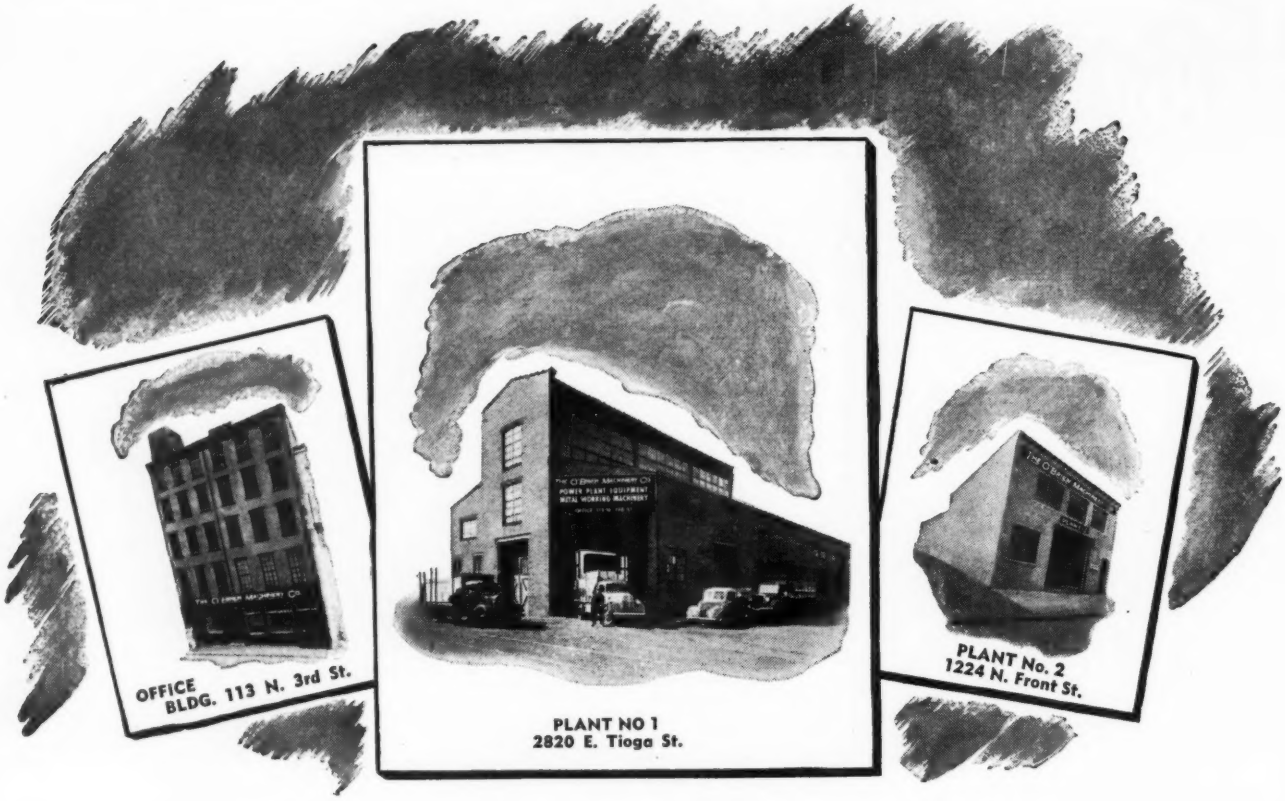
+INTEGRITY=THE BELYEA METHOD OF OPERATION



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Ask any of our customers 'round the world. They know The O'BRIEN Machinery Company as a *solid* organization with a *firm* foundation.

For almost thirty-five years—since 1915—we've been serving your industry from our five story office and showroom building and from two plants having extensive shop and warehousing facilities. All sales and technical recommendations are supervised by graduate engineers, and mechanical work is capably performed by our own mechanics, who are craftsmen in their respective fields.

Without a doubt the name O'BRIEN is synonymous with dependability in the procurement of power plant, electrical and metal working machinery of all types—a complete variety is carried in stock at all times for immediate delivery . . . Remember—when you require New, Used or Rebuilt Guaranteed Machinery, you can save time and money by calling O'Brien at MArket 7-4180.

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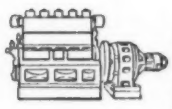

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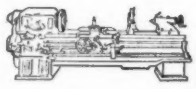
Turbo Generators — Engine Generators—Boilers—Diesel Engines — Blowers — Motor Generator Sets — Electric Motors — Air Compressors — Pumps — Heaters — Transformers — Complete Power Plants



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Everything from a Pully to a Powerhouse

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RIO DE JANEIRO—BRASIL

POWER Plant Equipment For IMMEDIATE DELIVERY

STOCK ELECTRIC MOTORS SPECIALS!

1—600 H.P. 9448 KW) 900 RPM Allis Chalmers, synchronous motor, 80% power factor, 3/60/2300 V. with direct connected exciter.

1—600 H.P. Westinghouse Type CW, slip ring, 3/60/2300/600 RPM Full magnetic control.

1—500 H.P. Westinghouse, synchronous, 3 phase, 25 cycle, 440 V. 750 RPM.

1—400 H.P. General Electric 440 RPM, type MT, slip ring motor, 3/60/2200 V., 3 bearing, serial #5054177.

1—400 H.P. General Electric, Type M, slip ring, 3/60/2300/600 RPM. Full magnetic control.

1—400 H.P. Westinghouse, types CS, 3/60/2300/1200 RPM.

4—250 H.P. 1200 RPM Westinghouse, type CS, squirrel cage open type normal torque motor, 3/60/2200 V., frame 955A, serials #4350783-B.

TURBO GENERATORS

1—1250 KVA G.E. Condensing 3/60/480 Surface Condenser 175/200 lb.

1—1250 KVA De Laval 3/60/2300 Non Condensing 250/350 p.s.i. 30/80 lb. B.P.

1—780 KVA Westinghouse Non Condensing 3/60/480/3600 RPM 125/200 p.s.i. 25 lb. B.P.

2—625 KVA G.E. Non Condensing 3/60/2400/3600 RPM New 1939—175 lb. 5 lb. B.P.

1—KVA Westinghouse 3/60/480 Non-Condensing 125 lb. 15 lb. B.P.

2—375 KVA G.E. Non-Condensing 3/60/2300/3600 175 lb. 5 lb. B.P.

1—250 KVA Kerr Non-Condensing 3/60/220 125 lb. 5 lb. B.P.

2—New 150 KVA O'Brien Non-Condensing 3/60/220/100 lb. 35 lb. B.P.

2—New 125 KVA O'Brien Non-Condensing 3/60/220/100 lb. 35 lb. B.P.

DIESEL GENERATOR SETS

50-60 Cycle

All Phila. Warehouse Stock

2—312 KVA General Electric 3 phase, 50 cycle, 400 volt, 750 RPM with direct exciter and Falk Coupling for Connection to and including 380 H.P. Chicago Model 89 CP, 4 cycle 8 cylinder, 9" Bore, 10½" Stroke, Diesel Engines—Including standard equipment, plus Heat Exchanger cooling; Intake Exhaust Silencer; Gasoline Starting Compressor and Tank; Switchboard with Instruments; Circuit Breaker, Voltage Regulator. 3 boxes Weights 21,700 lb. 3,350 lb., 8,350 lb. 416,270, 190 cubic feet. All equipment new.

1—125 KVA Electric Machinery Generator, 3 phase, 50 cycle, 230/400 volt, 1500 RPM, direct connected to 185 H.P. Hercules Model DFXH 6 cylinder, 4 cycle, Diesel, 5-3/4" Bore, 6" Stroke—Self Contained Voltmeter, Ammeter, Rheostat, Automatic Voltage Regulator, Radiator, Starting Battery, L. 122", W. 44", H. 76". Weight 9300 Lb. This is a brand new unit from the factory May 1948.

1—113 KVA Century 3 phase, 60 cycle, 220-440/1200 RPM with 150 H.P. Waukesha Model WAKH, 6 cylinder, 4 cycle Diesel Engine; Radiator Cooled; Metal Hood and Side Covers; Switchboard; Starting Batteries—Used 2 weeks. Guaranteed.

1—62.5 KVA Century 3/60/220/127 volt, 1200 RPM (53.8 KVA 3/50 cycle/230/400 volt/1000 RPM) with UD18 International 6 cylinder 4 cycle Diesel 4-3/4" Bore, 6-1/2" Stroke; Switchboard, Radiator; Hood and Side Covers; Starting Battery; Used 4 months; 122" L., 38" W., 76" H., Wt. 7450 Lb. Guaranteed.

50—37½ KVA Chrysler Model IND 6 cylinder 55 H.P. 1500 RPM, 3 phase, 50 cycle, 220/380 volt, radiator, standard equipment, spare parts, starting battery, switchboard with voltage regulator. Weight 3400 lb. These Units Brand New. Can start delivery immediately—completing 50 in 90 days.

4—25 KVA Westinghouse-LeRoi GASOLINE Generator Sets, 900 RPM, single phase, 60 cycle, 115/230 volt Radiator; Switchboard with Voltage Regulator; Fuel Tank; Starting Battery. Units used 3 weeks; Condition Guaranteed.

2—6.25 KVA Sheppard Model 7 Diesel Sets, Single Phase, 112/220 volt, 1200 RPM, Radiator, Starting Battery, Rheostat—New from Factory. Weight 1540 lb.

3—6.3 KVA Sheppard Model 7 Sets. Single Phase, 50 cycle, 110/220 volt, 1500 RPM; Radiator, Battery, Rheostat. New from Factory. Weight 1500 lb.

REBUILT AIR COMPRESSORS

Guaranteed

HORIZONTAL, BELTED & MOTOR DRIVEN

CFM	Type	Size	RPM	Max. Press.	HP
44	ER	5x4	500	110	7½
120	ER	8x6	350	55	15
136	ER	8x8	300	130	25
173	ER	9x8	300	100	25
368	ER	12x10	285	100	60
503	ER	14x10	285	60	65

AIR COMPRESSORS

Synchronous Motor Driven Direct and Belt Driven—1052 CFM

3—18x11x14 INGERSOLL-RAND Type XRE-2 horizontal, two stage, double acting, water cooled AIR COMPRESSORS, each having a piston displacement of 1052 CFM and an actual delivery of 888 CFM, 100 p.s.i. equipped with clearance control regulator, forced feed lubricator, intercooler and direct connected to 180 HP Type TS syn. motor 4000/2300/3/60/257 RPM Unity P.F. with 5½ KW 1150 RPM belted exciters 125 v., and Type CR 7065 magnetic full voltage syn. motor control panel. (Rebuilt and Guaranteed)

1050 CFM

1—18x11x14 WORTHINGTON Horizontal, two stage, double acting, water cooled AIR COMPRESSOR, piston displacement 1050 CFM, 888 CFM actual delivery at 257 RPM, 100 p.s.i., complete with unloader, intercooler, forced feed lubricator, and belt driven by a 175 HP type ATB 220/440/3/60 syn. motor Unity P. F. exciter and motor starting equipment. (Rebuilt and Guaranteed).

194 CFM

1—40-M INGERSOLL-RAND MOTOR COMPRESSOR, vertical, two stage, air cooled, having 2-7"x5" low pressure cylinders, and 1-6¼"x5" high pressure cylinders, and having a piston displacement of 194 CFM and an actual delivery of 155 CFM, 125# pressure and close coupled to a 40 H.P., 220/440 volt, 3 phase, 60 cycle, 900 RPM squirrel cage motor, including magnetic starter with push button. (Rebuilt and Guaranteed)

HIGH PRESSURE COMPRESSORS

8—NEW INGERSOLL-RAND Model 3321, Size 3½ and 3½x2¼x1x2½, Type 30, two stage, air cooled Air Compressors, piston displacement of 25 CFM, 2000 lb. pressure. 900 RPM, and requiring a 10 H.P. motor.

3—Model CJ Curtis vertical, two stage water cooled Air Compressors, equipped with forced feed lubrication, capacity 21 CFM, 550 RPM, 850 lb. pressure, and requiring a 10 H.P. motor.

"Everything From a Pulley to a Powerhouse"

THE O'BRIEN MACHINERY CO.

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RIO DE JANEIRO—BRASIL

GENERATE YOUR OWN POWER WITH "UTILITIES APPROVED" EQUIPMENT

TURBINE-GENERATOR UNITS

3 Phase, 60 Cycle

1875 KVA G. E. condensing 250 lbs. pressure, 2300 volts, 3600 RPM complete.

1563 KVA Allis condensing 200 lbs. pressure, 600 volts, 3600 RPM complete exciter, condenser, switchboard.

1563 KVA G. E. condensing, 300 to 400 lbs. pressure, 2300 volts, 3600 RPM complete exciter, surface condenser.

1250 KVA Allis automatic extraction condensing 300 lbs., 25 lbs. bleeder pressure, 480 volts, 3600 RPM complete exciter, switchboard and condenser.

1250 KVA G. E. condensing, 250 lbs. pressure, 480/600/2300 volts, 3600 RPM complete shaft exciter, switchboard and surface condenser.

1250 KVA G. E. condensing 200 lbs. pressure, 4150 volts, 3600 RPM complete exciter, condenser, panel.

1250 KVA, 480 volts, Allis-Chalmers, 150/175 lbs. pressure complete with surface condenser.

625 KVA G. E. condensing, 150-175 lbs. pressure, 480 volts, 3600 RPM complete exciter, switchboard, surface condenser.

625 KVA G. E. non-condensing, 150 lb. pressure, 15 lbs. back, 2300 volts, 3600 RPM complete exciter, panel.

375 KVA (2) G. E. condensing 400 lbs. pressure, 450 volts, each complete exciter, switchboard, surface condenser.

375 KVA G. E. condensing 125 lbs. pressure, 2300 volts, 3600 RPM complete surface condenser and panel.

125 KVA G. E. non-condensing, 175 to 200 lbs. pressure, 10 lbs. gauge back, 2300 volts, 3600 RPM complete.

100 KVA Westg. non-condensing, 125 to 150 lbs. pressure, 10 lbs. gauge back, 2400/600 volts, 3600 RPM.

TURBINE-GENERATOR UNITS

Direct Current

(2) 400 KW, 240 volts direct current Crocker-Wheeler—Worthington 440 lbs. pressure condensing steam turbine-generator units.

300 KW, 250 volts, General Electric; non-condensing turbine, 200 lbs. pressure, 40 lbs. gauge back.

200 KW (3) New General Electric 120 volts Marine type turbine generator units.

75 KW Allis Chalmers-Terry, 125 volts, 2400 RPM, 150 lbs. pressure non-condensing turbine generator unit.

60 KW (3) new Westinghouse 120 volt Marine type turbine generator units.

SYNCHRONOUS MOTORS

300 HP 80% P. F. G. E. type ATI, 2300 volts, 720 RPM synchronous motor.

900 HP Allis 3 phase, 60 cycle, 2200 volts, 150 RPM synchronous motor.

MOTOR GENERATOR SETS

1500 KW Allis-Chalmers 550/600 volts, 300 RPM direct current generator direct connected 2190 HP, 3 phase, 60 cycle 4000/6600 volts synchronous motor.

400 KW Gen. Elec. 275 volt DC, direct connected to 710 HP Gen. Elec. 3 phase, 60 cycle, 2300 volt, 720 RPM synchronous motor.

62½ KVA G. E. 3 phase, 60 cycle, 2300 volt, 1200 RPM alternator direct connected 75 HP, 3 phase, 60 cycle, 2300 volt motor.

50 KW Westg. 125 volt, 1200 RPM direct current generator direct connected 75 HP, 3 phase, 60 cycle, 2300 volt motor.

10 KW, 125 volts DC Gen. Elec. generator with 12 HP, 3 phase, 60 cycle, 220 volts, 1800 RPM motor.

DIESEL GENERATOR UNITS

Alternating Current, 3 Phase, 60 Cycle

375 KVA, 480 volt, 400 RPM Elliott-Ingersoll Rand Gas Diesel Engine Generator Units—a complete installation.

375 KVA Fairbanks-Morse, 240 volts, 300 RPM generator direct connected to 450 HP, 300 RPM, 6 cylinder, Model 32-E-14 full Diesel engine complete with switchboard.

(6) 125 KVA Westing., 450 volt, 1200 RPM, direct connected to Gen. Motors Diesel.

DIESEL GENERATOR UNITS

Direct Current

(4) 300 KW, 120/240 volts, 3-wire, 400 RPM Westinghouse direct current generators each direct connected to a 448 BHP Baldwin Diesel engine.

250 KW Crocker-Wheeler, 250 volt, 257 RPM generator direct connected to 360 HP, 6 cylinder late type Fairbanks-Morse full Diesel engine—complete.

125 KW G. E. 125 volts, 720 RPM generator direct connected 210 HP, 6 cylinder Fairbanks-Morse Diesel engine.

100 KW (6) Delco 3-wire, 250 volt generator direct connected to 150 HP, 1200 RPM, 8 cylinder Superior Diesel engine complete with switchboard.

STEAM ENGINE-GENERATOR UNITS

Direct Current

400 KW (2) G. E. 250 volts, 360 RPM generator direct connected to Skinner Unaflow vertical non-condensing engine, 150 lbs. pressure, 10 lbs. gauge back.

275 KW Westinghouse 250 volt, 350 RPM generator direct connected to Ames vertical Unaflow engine.

200 KW, G. E. 125 volt, 200 RPM generator direct connected Skinner Unaflow engine.

15 KW Crocker-Wheeler, 125 volts, 410 RPM generator direct connected to an American Blower vertical engine.

STEAM ENGINE-GENERATOR UNITS

Alternating Current, 3 Phase, 60 Cycle

1125 KVA G. E. 480 volts, 150 RPM generator direct connected to 28" x 36" Nordberg Unaflow engine.

625 KVA, 200 volts, Gen. Elec. 150 RPM generator direct connected Skinner horizontal Unaflow engine, 125/150 lbs. pressure.

500 KVA G. E. 240 volt, 360 RPM generator direct connected Skinner vertical Unaflow non-condensing engine.

500 KVA Westg. 460 volts, 164 RPM generator direct connected to 26" x 28" Skinner Unaflow non-condensing engine, 140 to 160 lbs. pressure, 0 to 10 lbs. gauge back.

312 KVA, 220 volts, Westinghouse 200 RPM generator direct connected Harrisburg-Fleming corlis engine, 125 lbs. pressure.

156 KVA, 240 volts, 240 RPM generator direct connected to 17" x 16" Skinner Counterflow non-condensing engine 100-125# pressure.

125 KVA Westinghouse 240 volt, 257 RPM generator direct connected to Ames Unaflow engine.

DIESEL ENGINES

(10) 900 HP General Motors, Model 12-567 ATL, 12 cylinders, 744 RPM Diesel engines complete with auxiliaries. Practically new.

ALTERNATING CURRENT GENERATORS

750 KVA Westinghouse 3 phase, 60 cycle, 460 volt, 150 RPM synchronous alternator.

560 KVA Allis 3 phase, 60 cycle, 240 volt, 360 RPM alternator.

500 KVA Westg. 3 phase, 60 cycle, 440/550 or 2300 volts, 514 RPM three bearing belted alternator.

400 KVA Allis 3 phase, 60 cycle, 480 volt, 240 RPM alternator.

300 KVA G. E. type ATI, 2300/440 volts, 720 RPM generator.

200 KVA Westg. 3 phase, 60 cycle, 2300 volt, 257 RPM engine type alternating current generator with direct connected shaft exciter and switchboard.

SPECIALS

5425 GPM Worthington 70' head, 1800 RPM centrifugal pump direct connected to 125 HP G. E. 3 phase, 60 cycle, 220 volt slip ring motor.

1 Allis-Chalmers jet condenser suitable for 2000 KW steam turbine-generator unit.

4400 sq. ft. Worthington surface condenser.

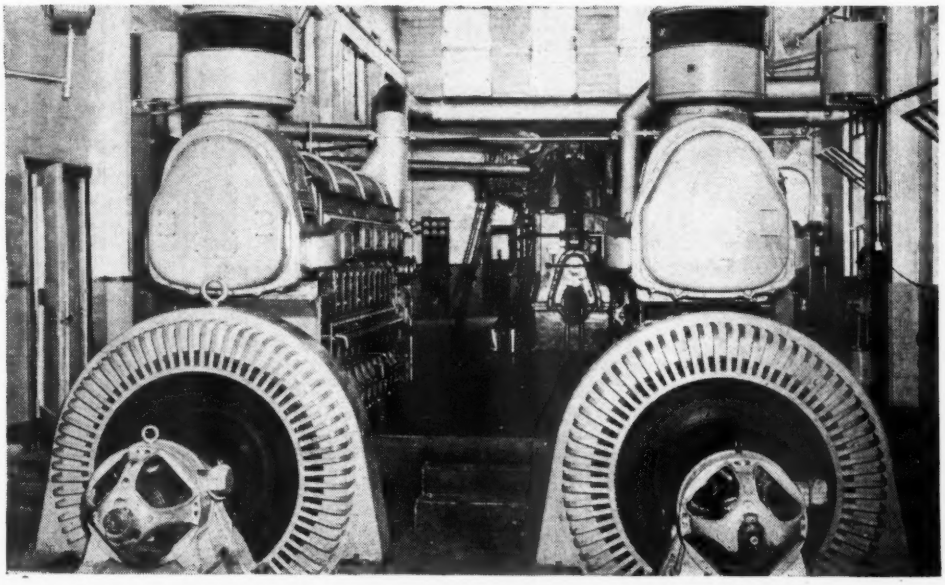
1250 sq. ft. Elliott surface condenser.

10 ton Capacity Brown hand operated traveling crane with 31'10" span including 150" of I-beams.

Utilities Electrical Machinery Corporation
600 NATIONAL CITY BANK BLDG.
CLEVELAND 14, OHIO
WIRE OR PHONE
LONG DISTANCE 422

DIESEL POWER FOR IDAHO FALLS

Another AGSCO INSTALLATION



Engineered and installed by A. G. SCHOONMAKER CO., INC., these 1250 KVA Fairbanks-Morse Diesel Engine Generating Units are in continuous service at the municipal power plant in Idaho Falls, Idaho.

INVENTORY AVAILABLE FOR IMMEDIATE SHIPMENT

KVA	Make	Model	HP	RPM	KVA	Make	Model	HP	RPM
1420	Fairbanks Morse	38D8 1/8	1600	720	300	Fairbanks Morse	YVA	360	257
*1250	General Motors	16-278A	1600	720	250	General Motors	8-268A	350	1200
1250	Nelseco	6MI-53	1500	300	125	Murphy	ME-605	145	1200
1000	General Motors	12-278A	1200	720	125	General Motors	3-268A	150	1200
*900	General Motors	12-567	1100	720	121	Fairbanks Morse	32E14	140	300
*625	Superior	OS	750	327	75	General Motors	6043C	90	1200
500	General Motors	6-278A	600	720	75	Fairbanks Morse	35-E8 3/4	90	450(BC)
425	Baldwin	VO-6	510	450	62	Int'l. Harvester	UD-18	76	1200
375	Enterprise	DSG-6	450	450	50	General Motors	4-71	60	1200
375	Worthington	HD-6	450	450	25	Lister	2 7/3	30	1200
312	General Motors	8-268A	450	1200	18	Int'l. Harvester	UD-6	22	1200

* ALSO AVAILABLE AS PORTABLE UNITS

Engineered AGSCO DIESEL POWER

A. G. SCHOONMAKER Company, Inc. ESTABLISHED 1898

Diesel Engines • Power Machinery

52 CHURCH STREET, NEW YORK 7, N. Y. PHONE DIgby 9-4350

Actually one of AMERICA'S LARGEST STOCKS!

PARTIAL LISTINGS ONLY

Reliably Rebuilt—YEAR Guarantee

288 KVA. A.C. Output—D.C. Input Motor Generator Set

Westinghouse Factory Built. Complete. A. C. Generator, Switchboard, and D. C. Automatic Starter for Motor.

3 Phase—60 cycle—450 Volt or 240 Volt—.75 Power Factor—A. C. Output—900 R. P. M.

SQUIRREL CAGE MOTORS

H.P.	Make	Type	Speed
450	G.E. vert.	KF-6338	1190
250	G.F.	IK	1160
250	G E (2)	K-568	575
200	G E.	KF-6335Z	880
147	West.	25 cy.	1750
125	West.	CS	600
125	Al. Ch. (2)	AR-630F	450
100	West.	CS-655C	1750
100	G.E. (2)	K-544	1175
100	G.E. (8)	K	1150
100	West.	CS	870
100	G.E.	K-6325	880
100	G.E.	KT-556	865
100	West. (2)	CS	690
75	West.	CS-505S	1760
75	West.	CS-662-C	1150
75	West.	CS	670
60	West.	504-S	1750
60	Rel.	AA-C5084Z	870
50	G.E.	FTR-523	3600
50	Elliott	196	3450
50	G.E.	K-445	1170
50	Century	SC-506	1160
50	West.	CS	800
40	G.E.	KT-336	900
40	West.	CS	900

Partial List Only!

SLIPRING MOTORS

600	Cr. Wh.		514
200	G.E.	MTP	1800
150	G.E.	MT-564Y	580
100	G.E.	IM	1800
100	Al. Ch.		690
75	G.E.	IM	690
60	Al. Ch.		690
60	G.E.	M-6326	705
50	West.	CW-554	1155
50	Al. Ch.	ARY	575
50	F-M	BV	575
50	G E.	IM	490
40	G.E.	IM	1200

SYNCHRONOUS MOTORS

H.P.	Make	Type	Speed
600	G.E.	TS	900
400	G.E. (4)	TS-982S	600
250	G.E.	TS	900
200	Ideal (2)		257
150	G.E.	TS	1200
125	West.	G	1200
100	West.	G	1200
100	G.E.	TS	1200
100	Elec. Prods.		1200

A. C. GENERATORS

200	KW	West.	G	1200
75	KW	G.E.	ATB	360
75	KW	G.E.	ATB	1200

D. C. to A. C. GENERATORS

K.W.	Make	D.C.	A.C.
25	G.E.	230	220
25	Star	115	120
25	Ideal	115	440
25	El. Mchy.	230	440
7½	Hertner	115	440
5	El Spec.	110	110

550 V. D. C. MOTORS

H.P.	Make	Type	Speed
765	G.E. (6)	MPC	1045/1350

230 V. D. C. Variable Speed Motors

150	Rel. (3)	1400-T	400/1200
100	Rel.	1050-T	400/1200
100	G.E.	CD-173	400/1200
75	G.E.	D	500/1500
75	Cr. Wh.	CMC-125H	375/750
60	G.E.	C	480/1100
55	Cr. Wh.	CCM-125H	165/500
50	West.	SK	500/1500
50	West.	SK	250/1000
40	G.E. (3)	CD-1441	400/1500
25	West.	SA	500/1500
25	Rel.	185-T	500/1500
25	G.E.	RF-13	400/1600
25	G.E.	RF-14	400/1200
25	G.E.	RF-14	300/1200
20	G.E. (6)	RF-12	400/1200
20	West.	SK	375/1500
15	West. (4)	SK-95	600/1500
15	E.D.		500/1500
15	West.	SK-120	350/1000
15	West.	SK	250/1000
15	West.	SK	500/1500
10	G.E.	RF-10	600/1800
10	G.E.	CD-83	600/1800
10	West.	SK	600/1200
10	West. (3)	SK	500/1500
10	G.E.	RF	400/1600
10	G.E. (3)	RF	400/1200
10	Rel.	131-T	250/1000
7½	West.	SK-70	500/1500
7½	G.E.	RF-10A	450/1600
7½	Al. Ch.		350, 1050
5	West. (3)	SK-60	500/1500
5	G.E.	RF-9	450, 1800
5	G.E.	RF	450/1800
5	Rel. (2)	46-T	400/1600

600 V. GENERATOR

K.W.	Make	Speed
200	Cr. Wh.	900
30	Burke	1750
30	E.D.	1150

250 V. GENERATOR

K.W.	Make	Speed
500	We.t.	1100
330	Elliot	1200
300	G.E.	1200
300	Al. Ch.	1200
200	G.E. M.G.	1200
150	West.	900
150	West.	1180
150	G.E.	600
50	G.E.	1200
30(3)	G E.	1750
30	Cont.	1200
25	G.E.	1200
15	G.E.	1750
10	Star	1750
7½	West.	1200
5	West.	1750

125 V. GENERATOR

K.W.	Make	Speed
250	G.E.	720
150	Cr. Wh.	1200
150	West.	1150
100(2)	West.	900
100	G.E.	1200
100	El. Mchy.	1200
75	Cr. Wh.	1200
75	Hertner	1150
50	Sturt.	2800
40	Cent.	1450
30	I..A.	1450
30	G.E.	1150
20	Delco	1200
15	G.E.	1150
10	Rogers	1450
7½	West.	1200
5	G.E.	1750

LOW VOLTAGE GENERATOR

Amp.	Make	Voltage
8000	H-V-W	6, 12
6000	M-B-O'C	6/12
5000	M-B-O'C (2)	6/12
5000	Col.	8/16
2000	H-V-W	6 12
1000	Chandeysson	6/12
1000	Col.	6/12
125	Hobart (8)	7½
3000	Chandysson	12/24
1000	H-V-W	12/24
300	Star	15
67	Cont.	15
750	Star	15
1000	G.E.	15
800	G.E.	22/23
600	Rel.	24
134	West.	24
175	Cr. Wh.	25
550	Col.	27
1600	G.E.	30
800	G.E.	30
100	G.E.	30
200	West.	30
205	G.E.	32
1000	G.E.	33
205	G.E.	42
24	G.E.	44/54
75	G.E.	50/10
800	G.E.	50

230 V. D. C. MOTORS

150	G.E.	RC-19	800
100	G.E.	RC-14	1750
75	West.	SK-170	635
75	West. (2)	SK-180	475
75	Cr. Wh.	52-HM	480
60	West. (2)	SK-160	680
50	West.	SK-133	1300
50	Diehl	K-10	850

230 V. D. C. MOTORS (Cont.)

50	West.	SK	750
50	West. (2)	SK-160	685
40	West.	SK-103	1750
40	Century	DN-454	1740
40	G E.	RC	1750
40	G E.	RC-32	1100
40	G.E.	RC-13	1075
30	G.E. (2)	RC	1200
30	West (2)		975
30	G F. (2)	RC-33	775
30	West. (2)	SK-143	575
20	G.E.	RC	1750
20	G E (2)	RC-11	1150
20	Star (2)	SR-316	29.2

115 V. D. C. MOTORS

100	Cr. Wh.	CMC	900
25	G.E. (2)	CD	1800
25	Cr. Wh.	CCM	750
20	Century	RS	1750
20	G E. (2)	CD-83	1750
20	West.	SK-110L	750
12½	G.E.	CDM-85	930/1160

TRANSFORMERS

300 KVA—Al. Ch. 3 phase, 4160 V. primary 230 V. secondary.
300 KVA—Pittsburgh, 3 phase, 4160 V. primary, 230 V. secondary.
300 KVA—G.E. 3 phase, 550 V. primary, 110/220 V. secondary.

NEW D. C. STARTERS

150—230 V. Magnetic 5 H.P. to 75 H.P. G.E.—C-H—A-B—W.L., etc.
100—230 V. Manual and Compound 1 H.P. to 5 H.P.—G.E. & C-H.
40—7½ H.P. 230 V. C-H—Magnetic reversing.

A. C. STARTERS

1—475 H.P. West. Magnetic Reduced voltage. 550 V. synch.
4—400 H.P. 440 V. C-H Bal. 9576 Mag. Red. Volt. Synch.
1—250 H.P. C-H 4150 V. synch. full voltage.
1—150/200 H.P. G.E.—440 V. CR-7068 Syn.
3—150 H.P. G.E. 220 V. Cr. 7061 Synch.

NEW A. C. STARTERS

40—C-H. & A-B 2 and 4 speed Magnetic up to 25 H.P.
20—50 H.P. C-H. 440 V. Magnetic.
165—20 H.P. W.L. 440 V. Magnetic.
635—7½ H.P. C-H. 440 V. Magnetic.

AIR COMPRESSORS

425 Cfm. Sullivan 2 stage.
360 Cfm. American 125 lbs.

ELECTRIC & AIR HOISTS

17—2 ton Shepard-Niles 230 V. D.C.
8—500 lbs. P & H. Zip Lift. 3 phase.
2—2 ton Yale & Towne, 3 phase.
1—1 ton Shepard-Niles, 3 phase.
1—½ ton Yale & Towne, 3 phase.
1—2 ton Thor, pneumatic.
1—½ ton Thor, pneumatic.

400 CY. GENERATORS

2—3 K W GE 3/400/110.
1—7½ K W GE 3/400/240.
1—10 KW GE 200/700 Cy.
1—15 KW GE 3/400/240.

EST. 1910 → L. J. LAND INC. ← 37TH YEAR

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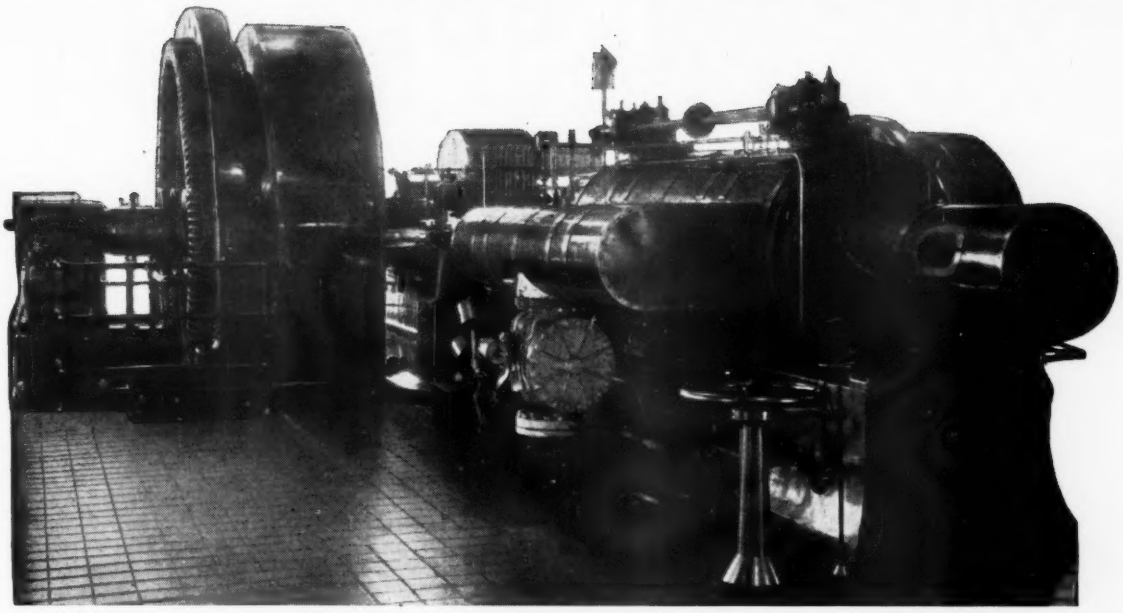
411 Atlantic Ave.
Phone: Liberty 4300

South Western Representative
HOUSTON, TEXAS, 1400 Carr St., Phone: Charter 4-6558

Pennsylvania Office:
READING, PENNA.
10th & Exeter Sts.
Phone: Reading 2-6866

POWER PLANT MACHINERY



Actual Photograph

500 KVA SKINNER UNIVERSAL UNIFLOW ENGINE GENERATOR UNIT

400 KW 80% P.F. 500 KVA General Electric alternating current generator, 3 phase, 60 cycle, 460/230 volts, 150 RPM, direct connected to Skinner Universal uniflow engine, 130-160# steam pressure, 0-5# back pressure. Complete with switchboard and auxiliaries. Excellent condition, can be shown in operation.

CONDENSING TURBO UNITS

3 phase 60 cycle

6000 KVA Westg., 2300 volts, 250# Steam
3125 KVA Westg., 2300 volts, 175/400# steam
1563 KVA G.E., 2300 volts, 225# steam
1250 KVA Westg., 2400 volts, 450# steam
1250 KVA (2) G.E., 2400 volts, 200/400# steam
750 KVA (2) Kerr, 480 volts, 150# steam, 5# extraction
625 KVA (2) G.E., 2300 volts, 160# steam
375 KVA (2) G.E., 450 volts, 400# steam

NONCONDENSING TURBO UNITS

3 phase 60 cycle

5000 KVA G.E., 13800 volts, 600# steam, 135# extraction, 25# exhaust
1250 KVA West., 2300 volts, 300# steam, 10# exhaust
937 KVA Allis, 4000 volts, 250# steam, 15# exhaust
625 KVA G.E., 240 volts, 175# steam, 5# exhaust
250 KVA G.E., 480 volts, 250# steam, 50# exhaust

UNIFLOW UNITS

3 phase 60 cycle

1125 KVA Nordberg, 480 volts, 160# steam, 5# exhaust
750 KVA Skinner, 460 volts, 150# steam, 5# exhaust
625 KVA Nordberg, 2300 volts, 160# steam, 5# exhaust
500 KVA Skinner, 450 volts, 130-160# steam, 0-5# exhaust
312 KVA Skinner, 480 volts, 115-140# steam, 0-5# exhaust
250 KVA (2) Skinner, 450 volts, 110-175# steam, 0-5# exhaust
200 KVA Skinner, 240 volts, 125-140# steam, 0-5# exhaust

SYNCHRONOUS MOTORS

6—3500 HP G. E. totally enclosed synchronous motos, 3 phase, 60 cycle, 1700 volts, 257 RPM. Equipped with surface air coolers and couplings. New 1943. These motors can be reconnected for 440 volts or rewound for 2300 or 4000 volts.

DIESEL UNITS

3 phase 60 cycle

1100 KVA (2) Nordberg, 2400 volts
1000 KVA Busch-Sulzer, 2400 volts
900 KVA Fairbanks-Morse, 2300 volts
500 KVA Fairbanks-Morse, 2400 volts
187 KVA (3) Buckeye, 240 volts
94 KVA (3) Caterpillar, 220 volts

MOTOR GENERATOR SET

60 KW General Electric interpole direct current generator 110 volts, direct connected to 85 HP General Electric induction motor, 3 phase 60 cycle, 440 volts, 1765 RPM. New 1943.

PACKAGE TYPE BOILERS

4—60,000 steam per hour Foster-Wheeler steel-encased boilers, two drum, bent tube, 435# pressure, 750 deg. total temperature, with water walls, superheaters, economizers, and Todd oil burners. New 1943.

INTERNATIONAL POWER MACHINERY CO.

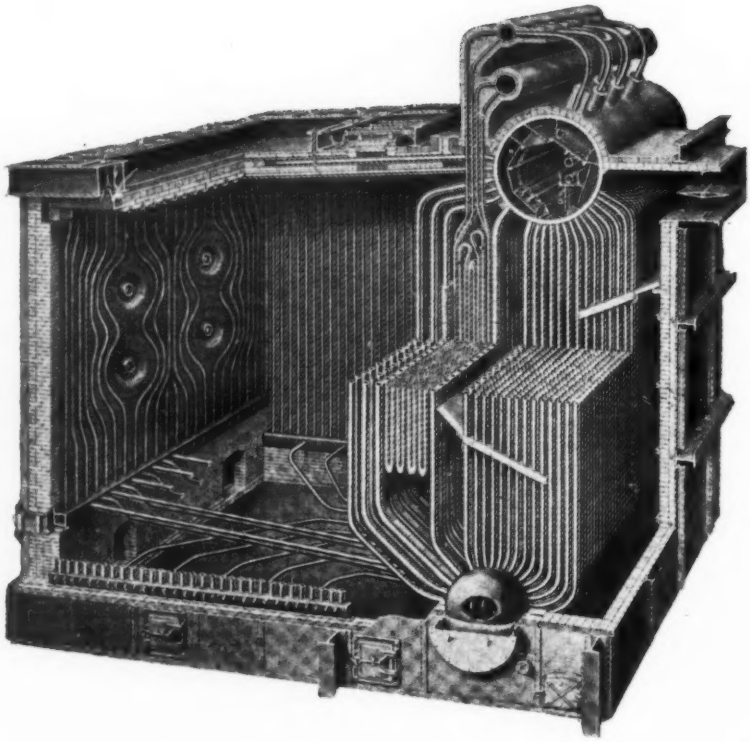
UNION COMMERCE BLDG. Telephone: MAin 9514 CLEVELAND 14, OHIO

BOILER SPECIAL

NEW

600#-psi., 750° FTT., TYPE V. U COMBUSTION ENGINEERING STATIONARY WATER TUBE BOILERS DELIVERING. 140,000# STEAM PER HOUR, COMPLETE WITH ALL TRIM.

IMMEDIATE DELIVERY



BULLETIN 350

Contains Drawing and Specifications Covering These Boilers

SEND FOR IT TODAY: IT'S FREE

Above 4000 HP. V. U. Combustion Engineering ASME. Code Boilers (3) Are Offered at a Saving of 40% on Today's Mfrs. Price and Immediate Delivery from Warehouse Given.

Owned and For Sale by

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Electrical - Mechanical Engineers
41st Floor Penobscot Building
Detroit 26, Michigan

TELEPHONES:
CADILLAC 1340
CADILLAC 1341

WHAT POWER PLANT EQUIPMENT HAVE YOU FOR SALE?

GLOW

SQUIRREL CAGE MOTORS

HP	RPM	Volts	Make
750	900	6600	Westgh.
350	514	440	GE-I
250	600	2300	Triumph
200	490	2200	GE
200	600	440	Westgh.-CS
150	600	2200	GE
125	1200	440	Century
100	1800	2300	Burke
100	1200	440	C-W
100	720	220	Westgh.
85	3600	2200	GE
75	900	2300	GE
75	720	2300	Wagner
75	360	220	GE-I
60	3600	2300	GE-KT
60	1800	440	Al. Ch.
60	1800	2300	GE-FTR
50	3600	440	R. & M.
50	1800	220	GE-KT
50	900	220	GE
50	720	2300	Wtg.-CS
40	1200	220	GE-KT
40	900	2300	Wtg.-CS
40	900	220	Lincoln
40	720	440	GE-KT
35	900	220	GE-KT
35	600	220	FT. Wayne
30	1800	dual	Delco
30	1200	dual	Master
30	720	220	GE-HI
30	514	440	Stanley
25	3600	dual	L-A
25	1800	dual	GE
25	1200	220	Wesche
25	900	440	GE
25	900	220	GE-FTR
25	720	220	Wagner
25	600	440	GE-I
20	3600	dual	GE
20*	1800	220/440	Master
20*	1800	220/440	Wesche
20	1200	440	Al. Ch.
20	900	440	Wtg.-CCL
20	600	220	GE
15	3600	220	GE-KT
15	1800	220	W-E
15*	1800	220/440	Master
15	1200	220	Ridgeway

ENCLOSED SQUIRREL CAGE

HP	RPM	Volts	Make
125*	1200	440	GE-TE-FC-BB
60	900	440	GE-TE-FC-BB
30	1800	dual	Delco
30	1200	440	Wagner
30	900	440	Reliance, TE-FC-BB
20	1200	440	Wagner
20	900	440	GE-TE-FC-BB
15	1800	dual	Delco
15	1200	220/440	Delco-TEFC-BB
15	900	440	GE, TE-FC-BB
10	1200	440	GE-TE-FC-BB
7½*	1800	dual	Wagner-TEFC-BB
7½*	1800	dual	Master-TEFC-BB
7½	1200	dual	GE-Hi Slip-TEFC-BB
7½	1200	dual	Delco
7½	900	dual	Delco-TEFC-BB
5	3600	dual	Delco-TE-FC-BB
5*	1800	dual	Master-TEI C-BB
5	1800	220	Wagner TE-BB
5*	1200	dual	GE-TEFC-BB
3	3600	dual	Delco, TE-FC-BB
3	1800	dual	Delco-TEFC-BB

*New Motor.

ENCLOSED SQUIRREL CAGE—Cont'd.

HP	RPM	Volts	Make
3	1200	dual	Rel-TEFC-BB
3	900	dual	Delco
2	1800	dual	Delco-TEFC-BB
2	1200	220	GE-TE-BB
2	900	220	Wagner-TE-BB
1½	900	dual	Delco-TEFC-BB
1½	1800	dual	L. Al.-TE-BB
1½	1200	dual	Ref-TE-BB
1	3600	220	Haskins-TEFC
1	1800	dual	Master-TEFC-BB
1*	1800	dual	Delco-TE-BB
1*	1200	dual	Rel-TE-BB
¾	3600	4400	Delco-TE
¾	1800	dual	Wesche-TE-BB
½	3600	220	Ohio-TE-BB
½	1800	440	Wtg.-TE-BB
½	1800	440	Delco-TE-BB
½	1800	dual	Delco-TE-BB
½	1200	220	Cr. Wh.-TE
½	900	dual	Delco
½	3600	dual	Delco
½	1800	dual	Delco

SLIP RING MOTORS

HP	RPM	Volts	Make
500	900	440	GE-3 Brg.
400	1200	2300	Al. Ch.
400	514	4600	Al. Ch.
375	1800	2300	Al. Ch.
350	900	2300	Westgh.
250	300	2300	Al. Ch.
235	1800	220	GE-I
75	1800	220	GE
60	1800	dual	Al. Ch.
60	900	2300	Burke
60	900	220	Wesche
50	900	2300	Ridgeway
50	900	440	Wagner
50	720	440	Al. Ch.
50	1800	220	GE-MT
40	1200	220	GE-MT-336
40	900	220	Wtg.-HF
40	720	2300	Wtg.-HF
40	720	220	Al. Ch.-ARY
40*	600	2300	Al. Ch.-ARY
40	600	220	Al. Ch.-ARY
40	450	220	Triumph-C
35	1200	220	Westgh.
35	900	220	Al. Ch.
35	900	2300	Ridgeway
35	720	220	GE
35	900	2200	GE
30	1800	2300	Wtg.-CW
30	1800	220	GE
30	1200	440	Wagner
30	1200	2300	Lincoln
30	900	220	GE-MT
30	900	2300	F-M
30	720	220	GE-I
30	600	220	F. Morse-BV
25	1200	220 440	Watson-KH
25	900	220	GE-MT
25	600	220	Watson

VERTICAL MOTORS

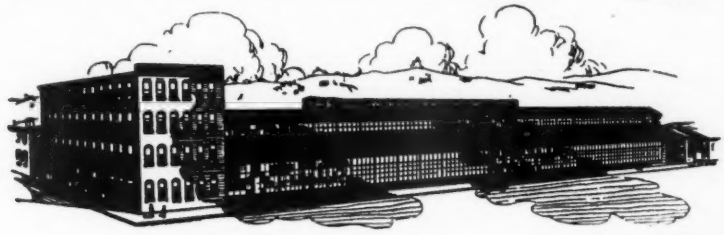
HP	RPM	Volts	Make
200	1200	440	Al. Ch.-SR
150	1200	2200	GE-I-SR
150	1200	440	GE-Cage

VERTICAL MOTORS—Cont'd

HP	RPM	Volts	Make
125	1200	2300	Al. Ch.-Cage
100	1200	440	GE-Cage
75	1200	2200	GE-Cage
75	360	220	Ideal-Cage
60	1800	230 D.C.	GE
60*	1200	440	Al. Ch.-Cage
50	1200	2200	Wtg.-Cage
50	600	440	Al. Ch.-Cage
40	1800	220	GE-Cage
40	1700	230 D.C.	GE
40	1200	440	Wtg.-SR
35	1800	440	GE-Cage
35	1200	2300	Al. Ch.-Cage
35	450	440	GE-Cage
30	1200	dual	Wtg.-Cage
25*	1550	230 D.C.	GE
25	1200	2200	GE-Cage
25	850	230 D.C.	Wtg.
20*	1800	440	Al. Ch.
20*	1200	440	Al. Ch.-Cage
15*	1800	440	Al. Ch.-Cage
15	1750	110 D.C.	Wtg.
15	1150	230 D.C.	GE
15	600	440	Al.-Ch.
12½	900	220	L. Al.-Cage
10	3400	230 D.C.	Wtg.
7½	1800	500 D.C.	Peerless
7½	900	440	Burke
7½	700	230 D.C.	GE
6	850	110 D.C.	Rel.
5	1400	230 D.C.	R. & M.
5	600	440	GE-Cage
4	1650	110 D.C.	Watson
3	1700	230 D.C.	Watson
3	1200	dual	Wtg.-Cage

SYNCHRONOUS MOTORS

HP	RPM	Volts	Make
3000	720	4800	GE-ATI
1015	500	2200	Wtg.-25 cycle
710	720	13200/6600	GE
700	500	11000	GE-25 cycle
500	600	4160	GE
350	750	4000	GE-25 cycle
300	750	440	GE-25 cycle
250	720	440	GE-ATI
250	225	2200	GE-TS
250	225	440	GE
220	600	2300	GE-ATI
200	720	440	GE-TS
200	225	2200	Wtg., rotor & stator
160	600	440	GE-ATI
115	164	208	GE
95	1200	220	Burke
75	1200	220	Westgh.
60	360	2200	GE, rotor & stator
50	1200	440	Wagner
50	900	220/440	Westgh.
50	720	440	GE-TS
50	360	440	GE, rotor & stator
30	900	440	Wagner
30	600	550	GE, rotor & stator
30	450	dual	Wtg., rotor & stator
30	360	550	GE
30	327	220	E-M, rotor & stator
25	1800	220	Wagner
25	450	220	E-M, rotor & stator
25	300	220	Ideal
20	1200	440	Wagner
20	900	220	Wtg.
20	600	220	E-M, rotor & stator
15	1800	220	Wagner
10	1800	220	Wagner
10	1200	220	Wagner
7½	1200	410	Wagner



AIR COMPRESSORS

2—Worthington, 11x12, horizontal, 328 CFM at 270 RPM Air Compressors, 100 lbs. pressure with or without motor.

1—Worthington, Feather Valve, 8½x9, horizontal, 170 CFM at 300 RPM Air Compressor, 100 lbs. pressure with or without motor.

D. C. MOTORS

115 Volts

HP	RPM	Description
225	750	GE-MPC
60	1200	Star
35	975	Northern
30	1800	F-M
30	200/600	Sprague
25	1150	Triumph
25	750	GE
20	700	Triumph
20	500/1500	GE-RF11
20	400/1200	GE-RLC fr. 202A
15	1200	J. & L.
15	975	F-M
15	725	Westgh.-S fr. 6
10	650	J. & L. type CI
7½	3500	GE, type B
7½	1150	F-M, type CP
7½	975	Westgh.-S-3
7½	750	J. & L. type CI
7½	700	J. & L. type CI
7½	500/1500	Reliance-T-66T
7½	500	Westgh.-SK-BB
7½	170/220	Diehl-NG90
5	3600	Star-SF3-BB
5	1800	Wesche-BB
5	950	Swing-E-6

D. C. GENERATORS

125 Volts

KW	RPM	Description
500	750	GE-MCF
300	1500	GE-CC
100	1000	WE-DLC
100	900	C-W-CCD
80	400	J. & L.-G
65	1100	W-E, type ELC-7
60	1200	Star, type SQ single bearing
55	1000	GE-Type TD
35	1165	GE-DLC
31.25	1400	Westgh.-SK-single bearing

D. C. GENERATORS—Cont'd.

30	1200	Al. Ch., single bearing
25	1200	Westgh.-SK, single bearing
25	1100	GE-CI.
25	600	Al.-Ch.-E-127
15	3600	GE-BF
15	1100	Al. Ch.
10*	1750	Westgh.-SK-43
10	1200	Delco, single bearing
9	1100	R. & M.
9	400	F-M
7½	3600	GE-BR
4	750	Westgh.-SK501.
2	1400	Westgh.
2	1200	Westgh.-SK

D. C. GENERATORS

230 Volts

KW	RPM	Description
400	1200	Westgh.
200	375	J. & L.-type K
175	450	Westgh.
125	1400	Westgh.-SK-1301
50	1230	Al. Ch.-E-127
35	1800	GE-RC
30	300	Triumph
22½	765	Westgh.-SK
18	300	Burke
15	350	Westgh.-SK
15	250	GE-CD
5	1800	Reliance, BB
5	850	Triumph
1½	900	J. & L.-AI-7

ELECTRIC CO

AC & DC MOTORS • GENERATORS • PUMPS
SYNCHRONOUS MOTORS • CONTROL EQUIPMENT
MOTOR GENERATOR SETS • ELECTRIC EQUIPMENT
STEAM ENGINE GEN. SETS • SLIP RING MOTORS

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LIQUIDATION SALE—Modern Equipment

900 HP General Motors 12-567 Diesel Engine

Ask For Our Complete 1948 CATALOG

DISTILLING PLANTS

2—40,000 gallons per day, Foster Wheeler triple effect low pressure.
10—2000 gals. per day Kleinschmidt vapor compression distiller mfd. by Badger.
1—750 gals. per day, same as above.

MOTORS

3 Ph. 60 Cy.
6—3800 HP 1700 V 257 RPM G.E.
5— 700 HP 2300 V 128 RPM
D.C.
1500 HP 525 V DC 600 RPM W'hse.
667 HP 374 V DC 1300 RPM Elliott
444 HP 250 V DC 900 RPM Elliott
222 HP 230 V DC 3050 RPM W'hse.

GENERATORS

1200 KW 525 V DC 750 RPM All. Chalm.
1075 KW 375 V DC 750 RPM Elliott
700 KW 240 V DC 500/720 Elliott

TURBO-GENERATORS—A.C.

1—1000 KW All. Chalmers 3/60/600, 3600 RPM, cond., 140# steam press.
3—300 KW G.E. type AT1 3/60/450, 1200 RPM, cond., compl., with 40 KW exciters, condensers, switchboards.
2—250 KW G.E. type AT1 3/60/450, 1200 RPM, cond.
2—200 KW Westinghouse, 3/60/450, 1200 RPM cond. (NEW).
6—200 KW G.E. type ATB 3/60/450, 1200 RPM cond. and non-cond.
2—132 KW G.E. type ATB 3/60/450, 1200 RPM, cond.

TURBO-GENERATORS—D.C.

KW	Volts	Winding	Speed	Type
2—375	180/240	Shunt.	1200	non-cond.
5—300	120/240	Compd.	1200	cond.
12—150	120	Shunt.	1200	cond.
12— 60	120	Stab. Sh.	1800	cond.
3— 25	120	Stab. Sh.	1200	cond.

FIRE PUMPS

2—1000 GPM, 280 ft. head, bronze, 6" x 5", Allis Chalmers, driven by Hercules Diesels, model DWXDS, 90 HP at 1800 RPM.
30—500 GPM, 120# press. at 2450 RPM, 750 GPM, 200# press. at 2900 RPM, with 160 HP White gasoline motor, 8 cycle, L-head type or 110 HP Cadillac, type V-8 (engines for sale separately).

STEAM TURBINE (new)

1—110 HP Sturtevant, 250# steam. 10# exhaust, 1200 RPM.

HYDRAULIC PUMPS

5—Vertical quintuplex, 4⅝ x 10, 450 gpm at 128 RPM against 2500 p. s. i., mid. by Aldrich driven by 700 HP synchr. motors 3/36/2300.

CONDENSERS

(Most are new)

No.	Sq. Ft.	Make	Passes	Tubes	
7	3800	Wheeler	1	Cu Ni	⅝"
4	3300	Str. Wells	2	Alu-Brass	¾"
1	2200	Alco	2		
1	1135	Wheeler	2	Cu Ni	⅝"
4	1050	Conseco	2	Cu Ni	⅝"
1	750	Bethlehem	2		⅝"
30	400	All. Chalm.	2	Brass	⅝"
4	300	Wheeler	2		
8	155	Conseco	2	Brass	¾"

BOILERS

10—Cleaver-Brooks, 2000# steam pr. hr. 35# press.
3—Cyclotherm 3000 pounds steam per hour, 125# press.
8—Express Boilers, modified D type, Foster Wheeler 30,000# steam/hr., 435#.

HOISTS

10—100,000# pull at 10 FPM to 3000# pull at 400 FPM. 2 Gypsies 12000# pull at 125 FPM, driven by 50 HP 230v. D.C. motors 525—1800 RPM.
15—15,000# pull at 78 FPM, 3360# pull at 348 FPM and 2 auxiliary drums. Driven by Chrysler 28.35 H.P. gasoline engines. (NEW).

BLOWERS—AIR PUMPS

8—Blowers, Roots Connersville, size 16x18, serial No. 14862, capacity 5000 CFM against 6 lb. sq. in. ga. pressure or 3450 CFM when creating 20" Hg vacuum, with 200 HP motors 3/60/2200 (mfd. 1942). Also available: 1 R.C. Blower, size 20 x 23 with 350 HP motor.
1—Air Pump, Ingersoll Rand, type FS546, 5500 CFM, discharge press. 24.22 abs., intake press. 20.61 abs., with 125 HP motor 3/60/2300 (mfd. 1942).
1—Air Pump, Ingersoll Rand, type FS548, 6690 CFM, discharge press. 20.86 abs., intake press. 17.10 abs., with 150 HP motor 3/60/2300 (mfd. 1942).
1—Blower, Buffalo, size 60, type R, with 150 HP motor 3/60/2200.
4—Vacuum pumps, Nash Hytor, size MD574, with 2 HP motors 230V DC (mfd. 1944).

AXIAL FLOW FANS

12,000 CFM, 3" S.P. 3/60/450 Sturtevant
10,000 CFM, 3" S.P. 3/60/450 Clarage
5,000 CFM, 3" S.P. 3/60/450 La Del
35,000 CFM, 1" S.P. 230V. D.C. Wing
Rugged construction, acid resisting vanes, totally enclosed motors, all NEW

DIESEL ENGINES

HP	MAKE	MODEL	RPM	CYCLE	YEAR
1800	General Motors	16-238S	750	4	1943
1600	Fairbanks Morse	38D O/P	720	2	1944
1600	Hamilton	RB99-D.A.	700	2	1944
1600	General Motors	16-278A	720	2	1944
1200	General Motors	12-278A	750	2	1944
900	General Motors	12-567ATL	750	2	1942/44
300	Baldwin	6-cyl.	514	4	
300	Fairbanks Morse	38-O/P	1200	2	1936
225	Gray Marine	4½" x 5"	2100	2	1943
150	Superior	GDB-8	1200	4	1942/44

DIESEL GENERATOR SETS

AC	200 KW	3/60/450	1200 RPM	General Motors	8-268A	1943 rebuilt
	100 KW	3/60/450	1200 RPM	General Motors	3-268A	1943 rebuilt
DC	1200 KW	525V	750 RPM	General Motors	16-278A	1943
	650 KW	240V	750 RPM	General Motors	12-567	1943
	125 KW	120/240	600 RPM	Superior	VDMB	
	100 KW	120/240	1200 RPM	Superior	GDB-8	1942/44
	100 KW	120/240	1200 RPM	General Motors	3-268A	1943/44
	10 KW	120	1200 RPM	Hercules	DOOD	1943

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Our 43rd Year

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Quality and Service

"CERTIFIED REBUILT"

THE MARK OF DEPENDABLE ELECTRICAL EQUIPMENT

MOTORS . . . GENERATORS . . . M-G SETS

PUMPS . . . FANS . . . BLOWERS . . . SPEED REDUCERS

PARTIAL STOCK LISTING—WRITE, WIRE OR PHONE YOUR REQUIREMENTS

2—250 KW Allis Chalmers M-G Sets, DC 120/240V. output, 363 H.P. Synch. Motor, 3/60/440V. 1200 RPM, AC & DC panels, late model.

M-G SETS

KW	Mfr.	Input V	Output V
150	Cr. Wheeler*	220/440 AC	250 DC
105	Century b.b.	220/440 AC	70 DC
100	Gen. Elec.*	220/440 AC	125 DC
100	Whse. converter	440 AC	250 DC
75	Whse.	220/440 AC	125 DC
75	Star b.b.*	220/440 AC	250 DC
75	Star b.b.	240 DC	230/460 AC
50	Gen. Elec.	220/440 AC	125 DC
40	Whse.	220/440 AC	250 DC
35	Gen. Elec.	220/440 AC	48 DC
30	Ideal	220/440 AC	125/250 DC
30	Elec. Prod.*	220/440 AC	50 DC
25	G. E. NEW	220/440 AC	125 DC
20	Whse.	220/440 AC	250 DC
20	Cr. Wheeler	220/440 AC	180 cycles
15	Gen. Elec.	220/440 AC	125 DC

*Synch. motor drive.

D. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
150	Cr. Wheeler b.b.	TEFC	230	800
100	Whse.	SK181	230	50/900
100	Gen. Elec.	C	230	575/1000
90	Whse.	SK173	230	575/1150
75	G.E. New b.b. (2)	CDM	230	1750
75	Cr.W. New b.b.(5)	CMC	230	1150
75	Allis Ch.	E	230	500
75	Whse.	S13L	115	575
75	Gen. Elec.	BRC	115	1150
75	Northw'n.	K20	230	1750
65	Gen. Elec.	C	230	375/750
60	Whse.	SK	230	1700
40	Whse.	SK	230	1700
40	Whse.	SK133	230	850
35/50	Gen. Elec.	CD123	230	575/1150
35	Ideal (2)	DV350	230	400/1200
30	Whse.	S-7	115	900
30	Gen. Elec.	RC31B	230	1150
25	Gen. Elec.	RC31	230	1150
25	Sprague dyna.	LC	230	750/2000
25	Chand'son(4)	C13	115	850
25	G.E. b.b. NEW	CDM93	115	1150
25	Gen. Elec.	CD85	230	1750
20	Gen. Elec.	RF12	230	400/1600
20	Whse.	SK93	230	1150
20	G.E. b.b. NEW	CDM83	115	1750
20	Gen. Elec.	RC11	115	1150
20	Reliance	T	230	850
20	Gen. Elec.	DLC	230	500/1500
20	Gen. Elec.	CD85	230	1150
15	Gen. Elec.	LC	230	550/1100
15	Gen. Elec.	RC	115	1150
15	Roth	85RS	230	1750
15	G.E. b.b. NEW	CDM67	115	1750
15	Gen. Elec.	RC10	230	1150
15	Whse.(5)	SK90	230	825
15	El. Dyn. b.b. (2)	326	230	1750

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
600	Gen. Elec.	MPC	500	750
150	Cr. Wheeler b.b.	TEFC	250	1200
105	Century b.b.	1500a	70	1200
100	Gen. Elec.	RC17	125	1200
75	Allis Ch.	E	250	750
75	Whse.	S	125	600
75	Cr. Wheeler b.b.	CCD	250	1450
50	Reliance	T	250	1200
40	Whse.	SK	250	1150
30	Elec. Prod.	BB	50	1150
30	Gen. Elec.	RC	250	1500
30	Ideal 3 wire	HHR	125/250	850
25	G.E. NEW b.b.	CD93	125	1450
24	Whse.	SK	600	850
20	Reliance	T	250	1150
15	Gen. Elec.	RC	125	1200

A. C. MOTORS—25 CYCLE

H.P.	Mfr.	Type	Volts	Speed
150	Whse.	HF	440	500
50	G.E. int.	MTC5337	440	750
50	Allis Ch.	ANY	440	1500
50	G.E.	I-K	440	750

A. C. GENERATORS—60 CYCLE

KVA	Mfr.	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
500	Allis Ch.	3 brg.	240/480	360
250	Whse.	G	2300	600
156	G.E. 1 brg.	ATB7558	240/480	1200
150	Gen. Elec.	ATB	240/480	600
125	Elec. Machy.		2300	900
125	Whse.	G	240/480	720
125	Gen. Elec.	ATB	240/480	300
112	Gen. Elec.	ATB	240/480	900
100	Whse.	G	2300	900
100	Gen. Elec.	ATB	240/480	1200
90	Fair Morse	AB	240/480	900
63	El. Machy.	180 cy.	240/480	1800
56	Gen. Elec.	ATB	240/480	900
50	Cont. b.b.	S107	120/208	1200
25	Whse. b.b.	1 ph.	120/240	900
12½	Whse. b.b. NEW		240	1200

A. C. MOTORS—SLIP RING

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	600	Gen. Elec.	I-M	360
1—	450	Whse. 2200 V.	CW	600
1—	400	Whse. 2200 V.	CW	450
1—	300	G.E. 2200 V.	I-M	1800
1—	225	G.E. int. duty	MTC5564	600
1—	150	Whse.	HF13AH	720
1—	150	G.E. 2200/4000 V.	I-M	1200
1—	150	G.E. int. duty	ITC-15	720
1—	150	Allis Ch.	ANY	600
1—	125	Gen. Elec.	IM-15	720
1—	100	Allis Ch.	ANY	1800
1—	100	Al. Ch. b.b. NEW	ARY	600
1—	100	Allis Ch.	ANY	720
2—	100	Whse. int. 2200 V.	C1856C	600
1—	100	Allis Ch.	ARY	900
2—	75	Gen. Elec.	IM-14	720
1—	75	G.E. int. duty	MTC5342	900
1—	75	Ideal int.	AVE	1200
1—	75	Gen. Elec.	MT558	600
2—	75	Gen. Elec.	IN-14	600
1—	75	Gen. Elec.	MT337	1800
•2—	50	Allis Ch.	ANY	900
1—	50	Howell	SR437	1200
1—	50	Fair. Morse	BV	720
1—	50	Gen. Elec. int.	ITC	600
1—	50	Whse. int.	CI	600
1—	50	Gen. Elec.	I-M	720
1—	40	Gen. Elec.	MT336	900
1—	40	Gen. Elec.	MT327	1800
1—	37	G.E. int.	ITC	600
1—	35	Lancashire	b.b.	1800
1—	30	Gen. Elec.	OMT336	1200
1—	30	Gen. Elec.	MT346	600
2—	25	Gen. Elec.	MT332	900
1—	25	Triumph	SR	1200
1—	25	Gen. Elec.	I-M	600
1—	20	G.E. int.	MTC5312	900
1—	20	G.E. b.b.	MT503	1900
1—	20	P & H b.b. int.	WT8	1200
1—	20	Gen. Elec.	MT332	720
2—	20	G.E. int.	MTC5302	1200
1—	15	Gen. Elec.	MT502	1200
1—	15	P & H b.b. int.	W7	1200

A. C. MOTORS—SYNCHRONOUS

H.P.	Mfr.	Type	Volts	Speed
667	Gen. Elec.	ATI	2200	450
300	Whse.	G	2200/440	600
250	Ideal(2)	2BC-M4	2200	450
200	Gen. Elec.	TS	220/440	600
150	Gen. Elec.	A1I	2200	450
150	Gen. Elec.	ATI	220/440	300
150	Gen. Elec.	ATI	220/440	600
125	Whse.	G	2300	900
125	G.E. 80% Pf.	TS7556	220/440	900
125	G.E. splprf.	TS955	220/440	1200
100	American b.b.	YGH	220/440	900
60	Gen. Elec.	ATI	220/440	900

A. C. MOTORS—SQUIRREL CAGE

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	200	Reliance b.b. NEW	C6085	1200
1—	200	Reliance b.b. NEW	C6085	1800
1—	200	Allis Ch.	AN	1200
1—	200	L. Allis 220/3800 V.	OGK-144	900
1—	150	Reliance b.b. NEW	14C6085	720
1—	150	Whse. 2200 V.	CS771-1C	1800
1—	150	Reliance b.b. NEW	B6085	1200
1—	150	Reliance b.b. encl.	AA	900
1—	125	Reliance b.b. NEW	C5085	1200
2—	125	Allis Ch. 2200 V.	AN	1200
1—	125	Gen. Elec.	IK-16	450
1—	125	Cont. 2200 V. b.b.	SC	1800
1—	125	Rel. TEFC NEW	B6085	1800
1—	100	Reliance b.b. NEW	C5085	900
1—	100	Elec. Machy.	b.b.	1200
1—	100	Rel. TEFC NEW	C5085	1200
1—	100	G.E. b.b. NEW	K5048	1800
1—	100	Cont. TEFC	NP682	1200
1—	75	Reliance b.b. NEW	C5084	900
1—	75	Reliance TEFC NEW	C5084	1200
1—	75	Reliance b.b. NEW	C505	1800
1—	75	Gen. Elec.	KT329Y	3600
1—	75	Whse. hitorq	CS-607	1200
2—	75	Reliance b.b. NEW	C505	1200
2—	60	Reliance b.b. NEW	B504	1800
2—	60	Rel. TEFC NEW	C505	1200
2—	60	Reliance b.b. NEW	C504	1200
2—	60	Whse. H. T.	CS504	1800
1—	60	Wagner b.b.	RP444	3600
1—	60	Allis Ch. 4000/2200 V.	AR623	1800
1—	50	Whse. b.b. NEW	CS405S	1800
1—	50	G.E. 2 phase	I-O	900
2—	50	G.E. NEW b.b. HT	KG405	1800
2—	50	Reliance b.b. NEW	C445	1200
2—	50	Gen. Elec.	KT336	1200
1—	50	Gen. Elec.	KT342	900
2—	50	Whse. hislip	WL607	900
1—	40	Al. Ch. 3 speed	ARX	900/600/450
5—	40	Gen. Elec.	KT336	900
2—	40	Reliance b.b. NEW	C404	1800
2—	40	Rel. TEFC NEW	C445	1200
2—	40	G.E.	KT	1200
2—	35	Gen. Elec.	I-K	720
2—	30	Howell b.b. speed	SC	1800
2—	30	G.E. NEW b.b.	K365	1800
2—	30	G.E. NEW hitorq	KG365	1800
2—	30	G.E. TEFC b.b.	K404	1800
1—	30	Gen. Elec.	I-K	900
1—	30	Gen. Elec.	KT336	720
1—	30	Wagner	22T8P	900
1—	30	Whse.	CS646	900
2—	30	Reliance b.b. NEW	C405	1200
2—	30	Reliance TEFC NEW	C444	1200
3—	30	Cr. Wheeler b.b.	SC 30Y	1800
2—	25	Rel. TEFC NEW	C444	900
3—	25	Reliance b.b. NEW	C364	1800
2—	25	Reliance TEFC NEW	B365	1800
2—	25	Reliance b.b. NEW	C404	1200
2—	25	Reliance TEFC NEW	C405	1200
2—	25	Whse. NEW spl. b.b.	CS365	1800
1—	25	Gen. Elec.	IK	1200
3—	25	Whse.	CS646	900
2—	25	Gen. Elec.	I-K	600
1—	20	Reliance b.b. NEW	C404	900
1—	20	G.E. TEFC b.b.	K404	1200
4—	20	Reliance b.b. NEW	C364	1800
2—	20	L.A. NEW exp. prf.	EX364	1800
2—	20	Whse. NEW b.b. spl.	CS364	1800
2—	20	Gen. Elec.	KT312	1200
2—	20	Gen. Elec.	I-K	1200
1—	20	Whse.	CS	1200
1—	20	Gen. Elec. b.b.	I-K	900
2—	20	G.E. NEW b.b.	K365	1200
2—	20	Diehl TEFC NEW	INF364	1800
2—	20	Century b.b. 4 speed	SC594	1800
2—	15	Whse. Splashprf.	C3365	1200
4—	15	G.E. NEW b.b.	K324	3600
2—	15	Whse. NEW TEFC	CS326	1800
1—	15	Diehl TEFC NEW	INF365	1200
4—	15	Gen. Elec.	KT302	1200
1—	15	Gen. Elec.	KT512	900
1—	15	L. Allis	OX365	900

EXPLOSION PROOF MOTORS

from 1 to 20 H.P.....std. speeds

ARTHUR WAGNER COMPANY

1436-38 W. RANDOLPH STREET CHICAGO 7, ILL. MONroe 7409

Brew-Woltman offers
POWER PLANT EQUIPMENT

TURBINE UNITS

1— 9375 KVA Cond. 50 cy. 13800 V. 600-lb. 825 deg. FTT. With surface condenser and boiler. NEW.
1—12500 KVA West. Cond. 25 cy. 600 V. 200-lb.
1— 3750 KVA West. Cond. 60 cy. 2300 V. 200-lb.
1— 3125 KVA G. E. Cond. 60 cy. 2300 V. 200-lb.
1— 1563 KVA G. E. Extraction 60 cy. 2300 V. 400-lb. extraction 160-lb. Cond.
1— 1500 KVA West. Non-C. 60 cy. 2300 V. 150-lb.
1— 1250 KVA DeLaval Non-C. 60 cy. 2300 V. 250-lb.
1— 1250 KVA Allis Cond. 60 cy. 2300 V. 200-lb.
1— 1250 KVA G. E. Non-C. 60 cy. 480 V. 400-lb.
1— 1250 KVA West. Non-C. 60 cy. 2300 V. 275-lb.
1— 937 KVA G. E. Cond. extraction 60 cy. 480 V. 375-lb.
2— 625 KVA G. E. Cond. extraction 60 cy. 480 V. 375-lb.
1— 625 KVA G. E. Non-C. 60 cy. 240 V. 175-lb.
1— 600 KVA Allis Cond. 60 cy. 480 V. 150-lb.

WATER TUBE BOILERS

1—2000 HP B. & W. 450-lb. Pul. coal and oil
2— 600 HP B. & W. 350-lb. Stokers
1— 519 HP Titusville 200-lb. Stoker
2— 509 HP B. & W. 200-lb. Stokers
1— 500 HP Union City 400-lb. Pulverizer
1— 418 HP Comb. Engr. 400-lb. Stoker
2— 406 HP Union Iron Wks. 200-lb.
1— 180 HP Frost 200-lb. return tubular

STEAM ENGINE UNITS—60 Cy.

1—1250 KVA Nordberg Uniflow, 480 V.
1— 450 KVA Ames Uniflow, 2300 V.
1— 400 KVA Skinner Uniflow, 480 V.
1— 312 KVA Skinner Uniflow
1— 156 KVA Ames Vert. Uniflow, 240 V.
1— 150 KVA Ames Uniflow, 220 V.
1— 125 KVA Ames Uniflow, 2300 V.

D.C. STEAM ENGINE UNITS

2—750 KW Skinner Uniflow 250 V.
1—300 KW Skinner Uniflow 275 V.
1—275 KW Ames Vertical Uniflow 250 V.
1—200 KW Skinner Uniflow 250 V.
1—200 KW Skinner Uniflow 125 V.
1—100 KW Skinner Uniflow 230 V. 3-wire
1— 75 KW Ames Uniflow 125 V.

TURBINE SPECIALS

1—2187 KVA Turbine Plant 3/60/480 V. 3600 RPM 375-lb. PSI 15-lb. extraction with surface condensers consisting of 1—937 & 2—625 KVA units. Excellent condition. Immediately available.

1—1250 KVA Allis Chalmers turbo unit 3/60/2300 V. 200-lb. PSI 3600 RPM condensing. Splendid condition Allis Chalmers inspection report.

1—2815 KVA Turbine Plant 3/60/2300 V. 3600 RPM condensing extraction consisting of 1—1565 KVA 400-lb. PSI & 1—1250 KVA 160-lb. IP units including 450-lb. boilers with stokers, etc.

DIESEL ENGINE UNITS

6—1600 HP Fair. Morse 60 cy. 2300 V. NEW gen.
1— 720 HP Amer. Loco. 240 V. DC
1— 625 HP Worth. 240 V. 60 cy. gen.
1— 600 HP Fair. Morse 2400 V. 60 cy.
1— 400 HP DeLaVergne 2400 V. 60 cy.
1— 375 HP Worth. 240 V. 60 cy. gen.
2— 240 HP Fair. Morse 2400 V. 60 cy.
1— 150 HP Gen. Motors 3-378A-60-3-480
2— 135 HP Murphy 240V. 60 cy.

SYNCHRONOUS MOTORS—60 Cy.

2—3000 HP G. E. 1700 V. 257 RPM
1—2800 HP E. M. 2200 V. 225 RPM
1— 880 HP G. E. 6600 V. 514 RPM
2— 500 HP E. M. 2200 V. 514 RPM
3— 400 HP E. M. 440 V. 600 RPM
1— 350 HP G. E. 4800 V. 225 RPM
1— 300 HP G. E. 2300 V. 600 RPM
1— 300 HP West. 2300 V. 900 RPM
4— 150 HP West. 2200 V. 400 RPM
1— 100 HP G. E. 2300 V. 240 RPM (Super)

INDUCTION MOTORS

1—8000/1000 HP Cr. Wh. 2200 V. FL RPM 895/448
1—1200 HP Al. Ch. S/R 2200 V. 240 RPM
1—1000 HP G. E. S/R 2200 V. 514 RPM
3— 350 HP Elliott S/C 2300 V. 900 RPM
1— 300 HP West. S/R 2200 V. 1770 RPM
1— 250 HP G. E. S/R 2200 V. 1800 RPM
3— 200 HP E. M. S/C 480 V. 1800 RPM
1— 200 HP G. E. S/R 2200 V. 435 RPM
1— 150 HP Cr. Wh. S/C 440 V. 1800 RPM
1— 150 HP Al. Ch. S/C 440 V. 1200 RPM

FREQUENCY CHANGERS

1—6250 KVA G. E. 50/60 cy. 600 RPM
2—3000 KVA West. 25/60 cy. 300 RPM
1—2500 KVA G. E. 25/60 cy. 300 RPM
1—2150 KVA G. E. 25/62½ cy. 750 RPM
2—1000 KVA G. E. 25/60 cy. 300 RPM
1— 500 KVA Al. Ch. 25/60 cy. 300 RPM

MOTOR GENERATOR SETS

1—1500 KW Al. Ch. 600 V. DC 60 cy.
2—1000 KW Gen. Elec. 600 V. DC 60 cy.
2— 500 KW Gen. Elec. 250 V. DC 60 cy.
1— 400 KW Al. Ch. 275 V. DC 25 cy.
2— 300 KW Al. Ch. 275 V. DC 25 cy.
1— 250 KW Cr. Wh. 250 V. DC 60 cy.
1— 200 KW Gen. Elec. 60 V. DC 60 cy.
1— 75 KW West. 125 V. DC 60 cy.
1— 75 KW Ridgway 115 V. DC 60 cy.
1— 75 KW Star 240 V. DC 60 cy.
1— 18 KW West. 60 V. DC 60 cy.

ROTARIES—60 Cy.

1—2929/3705 KW Gen. Elec. 225/285 V.
1—2025/2565 KW Gen. Elec. 225/285 V.
1—2000 KW Allis Chalmers 600 V.
1—1500 KW Westinghouse 600 V.
2—1500 KW Westinghouse 270 V.
2—1000 KW General Electric 600 V.
1— 750 KW Westinghouse 275 V.
1— 500 KW Allis Chalmers 600 V.
1— 500 KW General Electric 275 V.

TRANSFORMERS—60 Cy.

4—7500 KVA Al. Ch.	33000-13800 V. 3 ph.
3— 667 KVA Pitts.	33000-11000 V.
3— 50 KVA G. E.	33000—2300 V.
3— 75 KVA Moloney	33000—2300/6900 V.
3—3750 KVA West.	26400/13200—2400 V.
1—8000 KVA Penn Auto	26400-13200/2400 V. 3 ph.
4— 450 KVA Al. Ch.	25410/44000—13280/23000 Y
3—1667 KVA Wagner	23000—575 V. 25 cy.
3— 750 KVA West.	22000-2300/4600 V.
2—4000 KVA Penn. Furnace	22000—228 V. 3 ph.
6—3000 KVA Al.Ch. Furnace	13200—200 V.
2— 200 KVA G. E.	11500—220/110 V.
3— 200 KVA Moloney	11000—2300 V.
3— 167 KVA G. E.	7200/12400 Y—240/480 V.
1—1500 KVA West. Auto	4000—2300 V. 3 ph.
1—2500 KVA West.	2400—480 V. 3 ph.
1— 100 KVA G. E.	2300—575 V. 3 ph.
3— 250 KVA Al. Ch.	2300—460 V.
3— 20 KVA West.	2200—575/287½ V.
3— 7½ KVA G. E.	600—120/240 V.
4—27½ KVA G. E.	440—220/110 V.

OIL CIRCUIT BREAKERS

2— 800 A. 87 KV Am. Brown Bov.	Outdoor
1— 400 A. 37 KV West G11	Outdoor
2— 400 A. 25 KV G. E. FK0136	Outdoor
2—1000 A. 23 KV Kelman CB76	Outdoor
4— 600 A. 15 KV G. E. FHK0139BS	Outdoor

VOLTAGE REGULATORS

3—130 KVA 96 A. 13200 V. Gen. Elec.
1— 72 KVA 300 A. 2300 V. Gen. Elec.
3— 46 KVA 200/400 A. 2300 V. West.
4— 36 KVA 150 A. 2400 V. Gen. Elec.
4— 36 KVA 75/100 A. 4800 V. Gen. Elec.
6— 24 KVA 100 A. 2400 V. Gen. Elec.
5 —12 KVA 50 A. 2400 V. Gen. Elec.

The Above Is Only a Partial List

TURBINES · ENGINES · BOILERS · PUMPS
DIESELS · GENERATORS · MOTORS · MOTOR GENERATORS
TRANSFORMERS · ROTARIES · COMPRESSORS · CONDENSERS, ETC.

42 Years National Service

BREW, WOLTMAN & CO., INC.

50 CHURCH STREET, NEW YORK 7, N. Y.

POWER EQUIPMENT—READY TO SHIP

SAVE OVER 50% ON NEW INDUSTRIAL BLOWERS AND VENTILATING FANS

AXIAL FLOW VENTILATING FANS

6—16000 CFM Buffalo Forge Co., 3" stat. pres. 1800/1200 rpm. con. 15/4.5 HP., 1710/1150 rpm., 3 ph. 60 cy. G.E. A.C. Motor 220/440 v. totally encl.

2—12000 CFM 3" stat. pres. Sturtevant with dir. con. 10/3 HP., 1775/1180 rpm., 220/440 v. West. CS. TEFC Motor.

1—7500 cfm Clarage with dir. con. 7½ hp., 1750 rpm., 3.3 HP. at 1160 rpm., 220/440 v. 3 ph. 60 cy.

31—6000 cfm Sturtevant Bulletin 512389, 3" stat. pres. 7 blade, dir. con. 5/1.5 HP., 1765/1175 rpm., 220/440 v. 3 ph. 60 cy. West. TEFC Motors.

2—5000 cfm Sturtevant 1.8 stat. pres. 4.2/1.25 HP., 1750/1150 rpm., 3 ph. 60 cy. 220/440 v. ball bearing motors.

2—4000 cfm 3" stat. pres. Sturtevant dir. con. 2 speed, TE Westinghouse 220/440 v. Motors.

BRAND NEW TURBO SET

Westinghouse Steam Turbine consisting of 200 kw., 220/440 v., 3 ph. 60 cy. 1200 rpm., 80% P.F. A.C. Generator—40 kw., 120 v. 1200 rpm., D.C. Exciter and Westinghouse Reduction Gear. — Non-condensing.

A.C. MOTORS—3 PH. 60 CY.

No.	H.P.	Make	Type	RPM	Volts
1 new	500	Elec. Mach.	Syn.	120	4000/2200 220/440
3	300	Elec. Mach.	Syn.	720	2200
2	250	G.E.	I	1200	2200
2	200	G.E.	I	860	2200
1	200	West.	CS	900	440
1	175	West.	MS	900	220
1	150	West.	MS	900	220
1	150	West.	Syn.	600	220/440
1	150	West.	Syn.	257	220/440
4	150	L. Allis	Splash Proof	1800	220/440
1	125	Elec. Mach.	Syn.	164	220/440
2	100	Reliance	IT	495	220/440
3	100	Elec. Mach.	Syn.	720	220/440
1	100	Allis Chal.		1200	220/440
1	100	West.		1200	220/440
2	100	Louis Allis	OGS	1750	220/440
5	100	Louis Allis	PA	1750	220/440
1	75	Stanley		600	220/440
1	75	Chandey	Syn.	600	220/440
1	75	Elec. Mach.	Syn.	900	220/440
1	75	Louis Allis	OGS	1200	220/440
2	75	Louis Allis	FAA	1150	220/440
1	75	G. Elec.	KT-543	1150	220/440
3	75	Armour	AXB	1180	220/440
1	75	Burke	EM-7	1200	220/440
2	75	West.	CS	1800	220/440
1	60	Burke	EM-7	900	220/440
1	60	G.E.	KT-543	900	220/440
3	60	Armour	AXB	900	220/440
1	60	West.	CS-658	1200	220/440
1	60	G.E.	KT-533	1800	550
1	50/32	G.E.	POS	800/640	220/440
1	50	West.	CS-658-A	870	220/440
1	50	Fynn-Weis.	22-V	900	220/440
2	50	G.E.	KT-346	900	220/440
1	50	G.E.	KT-342	1200	220/440
1	50	West.	CS	1200	220/440
1	50	American		860	220/440
1	50	G.E. T.E.F.C.	K-445	1770	220/440
1	50	West.	M-5[illegible]	1800	220/440

A. C. GENERATORS—3 ph. 60 cy.

No.	KVA	Make	RPM	Volts
1 new	450	Elec. Mach.	120	4000/2200 220/440
3	115	Elec. Mach.	720	220/440
1	100	Elec. Mach.	164	220/440
1	100	West.	600	220/440
1	75	Elec. Mach.	900	220/440
1	50	G.E.	1200	220/440
1 new	50	Elec. Mach.	1200	220/440
1	37½	Ft. Wayne	1200	220/440
1 new	25	G.E.	900	220/440
4	25	O'Nan	1800	220/440

BARGAIN — FOR SALE
100 KW. DIESEL ENGINE GENERATOR SETS

11—100 KW., 120/240 V. D.C. Delco Generators dir. con. to 150 HP., Model GBD-8, 5½x7, 8 cyl. Superior Diesel Engines, elec. starting with muffler, power panel and accessories.

Practically as good as new—Only Used for Spares.

250 VOLT D.C. GENERATORS

No.	KW	Make	Type	RPM
3	250	West.		1200
1	200	West.	SK	500
1	110	West.	SK-190	700
8	100	Reliance	1050-T	580
1	100	West.	SK-183	720
1	100	West.	SK-190	720
1	100	West.	SK-180	900
6	100	Delco		1200
1	100	G.E.	RC-58	850
1	100	West.	SK	850
1	100	G.E.	RCP-36	2100
1	75	Allis Chal.		850
2	75	West.	SK	1400
1	60	West.	SK	2100/1950
1	60	West.	SK-153	1100
1	50	West.	SK-180	400
1	50	G.E.	DLC-203	850
1	50	West.	SK-143	1100

MOTOR GENERATOR SETS—250 V.D.C.
Motors 220/440 volt or 2200 volt 3 phase, 60 cycle

No.	KW	Make	RPM
3	250	Westinghouse	1200
1	200	Westinghouse	720
2	200	Westinghouse	1200
1	100	Westinghouse	700
1	100	General Electric	900
1	100	Westinghouse	600
1	100	General Electric	1800
1	100	Reliance	580
1	100	Delco	1200
2	90	Westinghouse	680
4	75	Westinghouse	720
1	75	Westinghouse	1200
1	60	Westinghouse	1200
1 NEW	50	General Electric	1800
3	40	Westinghouse	900
2	30	Westinghouse	720

VARIABLE SPEED MOTORS—230 V. D.C.

No.	HP	Make	Type	RPM
1	200	West.	SK	400/1000
8	100	Reliance	1050-T	400/1000
1	100	G.E.	RC	650/1200
2	100	West.	SK-183-A	575/1150
1	100	West.	SK-190	500/1000
1	100	West.	SK	600/1200
1	75	West.	SK	1100/1800
2	75	West.	SK	850/1700
1	50	West.	SK-180	320/960
1	50	West.	SK	300/1200
1	50	West.	SK-191	350/1050
1	50	West.	SK-143	350/1750
1	40	Allis Chal.		400/1200
2	30	G.E.	DLE-50	400/1200
1	30	G.E.		800/1200
1	25	G.E.	CD-123	300/1200
1	20	West.	SK-123	400/1600
1	20	G.E.	RF-11	500/1500

SURFACE COMBUSTION GARDEN CITY HEAT TYPE EXHAUSTERS

3—#55 Single SSP, 14000 cfm at 1292 rpm., S.P. @ 70 deg. F and 3" water for 1200 deg. F. operation.

SPECIAL BARGAIN AIR COMPRESSOR

6—240 CFM Westinghouse type 3 VS-23 3 cyl. vert., 150 lbs. pres. dir. con. to 50 HP., 220/440 or 2200 v. 3 ph. 60 cy. West Slip Ring Motors, auto. control. Can furnish D.C. Motors or Oil or Gasoline Engines if desired.

SLIP RING MOTORS—3 ph. 60 cy.

No.	H.P.	Make	RPM	Volts
1 New	400	West.	600	2200
1	250	Allis Chal.	870	2200
1 New	200	G.E.	600	220/440
1	200	West.	1800	220/440
1	150	G.E.	1800	220/440
1	150	West.	1150	220/440
1	125	West.	860	2200/220/440
1	100	West.	720	2200/220/440
1	100	Triumph	580	550/220/440
1	75	G.E.	600	550/220/440
1	75	G.E.	720	220/440
1	75	G.E.	900	220/440
1	75	West.	1800	220/440
1	60	West.	900	220/440
1	60	G.E.	720	220/440
2	50	West.	870	220/440/2200

25 CYCLE A. C. MOTORS
3 ph. — 220-440 volts

H.P.	Make	Type	RPM
150	West.	CW	400
100	West.	CW	725
75	West.	MS	400
75	G.E.	M	715
60	West.	CS	1450
50	L. Allis	OGS-115	730
50	Armour	AB-1	720
50	West.		475
40	West.		725
25	West.	MS	715
20	West.	CS	715
20	Allis Chal.		715
15	Allis Chal.		1450
10	West.	CS	725

REDUCED VOLTAGE STARTERS—220 V. 3 ph. 60 cy.
7—100 H.P. Westinghouse Class 11-400
HUNDREDS of A.C. & D.C. BRAND NEW STARTERS all sizes—Gov. Surplus—BARGAIN PRICES

FREQUENCY CHANGERS

1—25 kw., 220/440 v. 3 ph. 180 cy., G.E. dir. con. to 25 HP., 1800 rpm., 220/440 v. 3 ph. 60 cy. motors.

SYNCHRONOUS MOTORS

1—New 500 HP., Elec. Machy. Co. 2200/220 or 440 v. 120 rpm.

ENGINE GENERATOR SETS

10—NEW 1 kw. 14.25 v. D.C. and 2 kw., 28.5 v. D.C. Homelite portable gas eng. Gen. sets. Can furnish lamps and batteries. Suitable for farms and camps.
3—5 kva. 120/240 v. 1 ph. 60 cy. Witte Diesel.
1—125 kva. G.E. 220/440 v. 3 ph. 60 cy., dir. con. Skinner UNIFLOW Engine.
1—50 kva. Elec. Machy 220/440 v. 3 ph. 60 cy. dir. con. Climax GASOLINE Engine.
1—125 kva. 220/440 v. 3 ph. 60 cy. 257 rpm., Erie Ball STEAM.

INDUCTION HEATING CONVERTER

New Van Norman, type indoor, floor, hi-freq. 32 kw. 220 v. 1 ph., 60 cy. 150 A. enclosed type.

HOISTS or WINCHES

200—1½ Ton HAND CRANKED ratio 27:1 thru an enclosed double reduction gear unit with 4 planetary gears mounted on steel plate complete with 48' of ¼" cable, ratchet type brake, push button release.

CAR PULLER or WINCH

1—Welen, 2 drum Winch or Car Puller rated 8600# per drum with 25 HP. G.E. Vertical Motor 230 v. D.C.

GEAR HEAD MOTOR

50 HP., G.E. 220/440 or 550 v., 3 ph. 60 cy., 1755 to 13 rpm., splash proof, ball bearing.

PORTABLE COMPRESSOR

1—315 CFM Ingersoll Rand portable 100 lb. pres. driven by 105 HP Waukesha Oil Engines, 860 rpm.

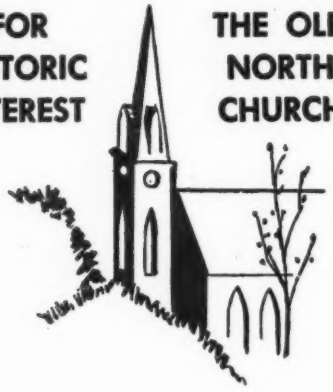
FOR SALE OR RENT

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

THINGS TO SEE IN BOSTON:

FOR HISTORIC INTEREST

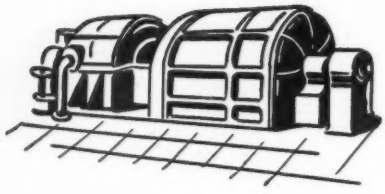


THE OLD NORTH CHURCH – *and if it's*

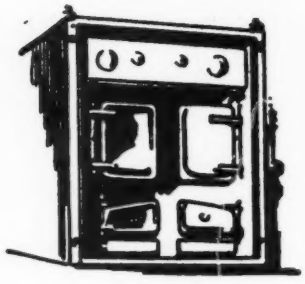
POWER PLANT EQUIPMENT

that interests you—See

A. LEE ELLIS CO. OF BOSTON



OUR NAME STANDS FOR QUALITY, FOR SERVICE, IN SHORT FOR



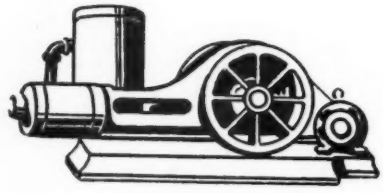
"New England Dependability"

TURBO-GENERATORS

1—3500 KW 2300 V Cond.
1—2500 KW 600 V Cond.
1—2500 KW 2300 V Cond.
1—3000 KW 600 V Cond.
1—2000 KW 600 V Cond.
1—1500 KW 2300 V Cond.
2—1250 KW 2300 V Cond.
1—1000 KW 2300 V Non-C.
2—1000 KW 440 V Cond.
1— 625 KW 2300 V Cond.
1— 600 KW 240 V Cond.
1— 500 KW 600 V Cond.
1— 500 KW 2300 V Cond.
1— 500 KW 480 V Extrac.
1— 250 KW 2300 V Non-C.
1— 250 KW 240 V Non-C.
1— 150 KW 2300 V Non-C.
1— 125 KW 600 V Extrac.
2— 125 KW 220 V Non-C.
1— 100 KW 600 V Non-C.
1— 50 KW 220 V Non-C.
1— 250 HP Turbine Gears
1— 375 HP Turbine Gears

ENGINE GENERATORS

2—400 KW 250 V. DC Vert. Uni.
1—375 KW 2300 V. Uniflow
1—168 KW 600 V.
1—168 KW 240 V.
1—168 KW 220 V. Uniflow
2— 96 KW 220 V. Uniflow



BOILERS

2—30,000# 425#
1—1030 HP 225#
1— 500 HP 400#
1— 300 HP 200#
1— 220 HP 160#
1— 200 HP 175#
6— 200 HP Sterling 160#
2— 190 HP 160# NEW
2— 510 HP Sterling 160#

AIR COMPRESSORS

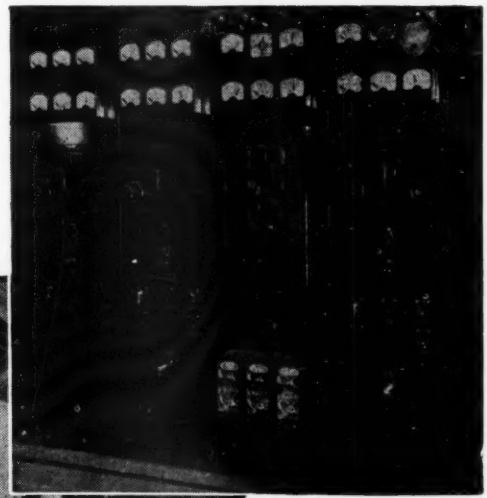
1—6000 CFM 50# Motor
2—5600 CFM 50# Motor
1—4500 CFM 100# Motor
1—1300 CFM 100# Motor
1—6000 CFM 5.1# NEW
1—5000 CFM 10# Rotary Type Motor

A. Lee **Ellis Co. of Boston** *Power Plant Equipment*

U. S. MACHINERY BUILDING
140 FEDERAL STREET BOSTON 10, MASS.

2 Complete, Modern

575 KVA SKINNER UNAFLOW ENGINE GENERATOR UNITS



2— 750 HP Skinner unaflow engines, each directly connected to 575 KVA Westinghouse 220 volt, 3 phase, 60 cycle, 150 RPM alternating current generator, with

15 KW "V" belt-driven exciters,

Complete switchboard control apparatus, with switchboard operated variable speed synchronizing devices and automatic voltage regulators.

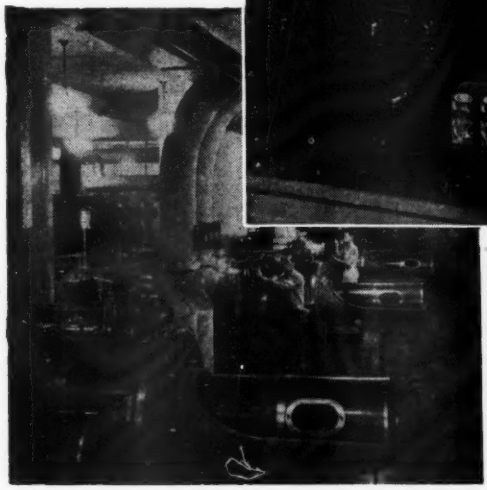
Also Available:

2— surface condensers with motor-driven circulating pumps.

2— 250 HP low pressure condensing steam turbines with auxiliaries.

This plant is one of the most modern medium-size steam power plants on the West Coast. It is complete in every detail.

The units were installed in 1935 and furnished complete power service for the building and presses of the Los Angeles Times. The plant has always been well maintained and is being removed from the Times Building now only because it is too small to furnish power for the building which is being enlarged to double capacity.



This complete steam power plant is offered for immediate shipment, F.O.B. Los Angeles. For further information write or telephone.

BEESON ENGINEERING CO.

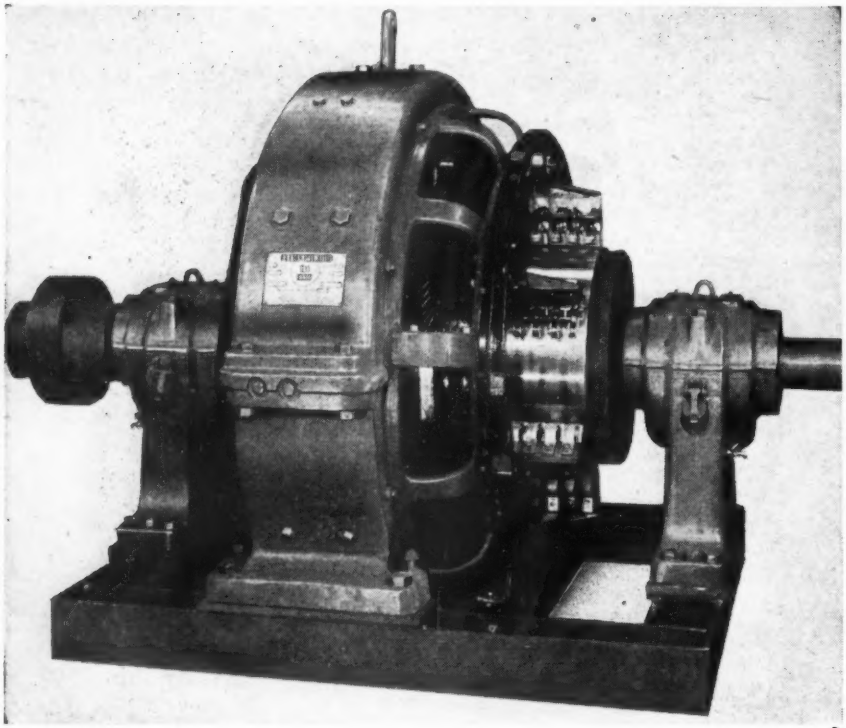
1628 E. 7th Street • Los Angeles, 21, California

***Telephone* MUtual 9151**

A-C's SELECTIVE LIST . . . . .

AUTHORIZED A-C DEALER

AN UP-TO-DATE LIST OF ELECTRICAL EQUIPMENT TO SUPPLY INDUSTRY'S NEEDS



A. C. SQUIRREL CAGE MOTORS
220/440 v., 3 ph., 60 cy.
(New except where shown as "R & G")

Qu.	HP	RPM	Make	Description
1	150	1750	Al. Ch.	R & G
1	150	600	Wstg.	CCL—R& G
1	125	1170	Al. Ch.	626 DS, SB
1	125	900	Al. Ch.	626 F
1	100	1760	Al. Ch.	623 AS, SB
2	100	1170	Al. Ch.	623 E
1	100	900	Al. Ch.	626 E, SB
1	100	720	Wstg.	CCL, 220 V, R & G
2	75	3500	Al. Ch.	445S, R & G
1	75	1750	Al. Ch.	505S, SB
1	75	1200	Al. Ch.	505, SB
1	60	1750	Al. Ch.	444S
1	60	1750	Al. Ch.	SB, R & G
1	50	3450	Ideal	A 120
6	50	1750	Al. Ch.	445
2	50	1200	Rel.	445
1	50	900	Al. Ch.	505

Complete ratings open, Totally Enclosed, and Explosion-Proof available below HP ratings listed.

D. C. ADJUSTABLE SPEED MOTORS
230 volts
(Reconditioned and Guaranteed)

Qu.	HP	RPM	Make	Description
7	15/20	400/1200	G.E.	CD 105
4	7½/10	450/1800	Rel.	92 T
3	40/50	250/1500	G.E.	CD 1441
2	50/60	300/900	E-D	30 S
1	135/175	450/1200	G.E.	MCF
1	200	300/900	Wstg.	

D. C. CONSTANT SPEED MOTORS
230 volts
(Reconditioned & Guaranteed except where shown "New")

5	5	320/534	G.E.	CD 93
13	3	850/1700	Rel.	23 T
1	30	850	Rel.	New
1	75	1330/1760	Rel.	383 T

D. C. GENERATORS
(Reconditioned & Guaranteed)

Qu.	KW	RPM	Make	Description
5	20	1200	G.E.	CD 93
2	75	1200	C-W	53 H
1	30	1200	G.E.	CD 113
9	5	1200	Rel.	23 T

SLIP-RING AND SYNCHRONOUS MOTORS
(Reconditioned and Guaranteed)

1—106 KW, 1200 RPM electric Machinery synchronous generator, 80% PF, 220/440-3-60, single-bearing.
1—250 HP, 600 RPM, 2200 volt, 3 ph., 60 cy., Lincoln 1XY slip-ring motor.
2—50 HP, 900 RPM, 220/440-3-60 Louis Allis slip-ring motors, frame 505, Type GH, complete with fully magnetic control and resistence bank, like new.

MOTOR GENERATOR SETS
(Reconditioned and Guaranteed)

Qu.	KW	D.C. Volts	A.C. Volts
25	3	250	220/440-3-60
5	5	250	220/440-3-60
1	30	125	220/440-3-60 (new)
1	60	125	220/440-3-60 (syn)
2	75	250	220/440-3-60
1	100	250	220 440-3-60 (syn)
1	125	250	2300-3-60
1	150	250	220-3-60

CONTROLS

New Cutler-Hammer Bul. 9141 Compensators, wide range of selection, 220 or 440 volts, in stock.

New and used A.C. starters, sized 1 to 5, 220 v and 440 v, available from stock.

New and used D. C. starters, constant or adjustable speed, sized 1 to 6 available from stock. (Suitable for motors from 1 HP to 200 HP, 230 v D.C. some suitable for 115 v D.C.)

MISCELLANEOUS

New P & H Zip-Lift Hoists, 250 lbs, to 1000 lbs., capacity, 220, 440 or 550 volts, available from stock.

1—New Robbins & Myers 5000 lb. Type S 3 BG Hoist, complete with hand geared trolley and totally enclosed motor, lifting speed 32 FPM, pendant rope control.

1—Chandesson 5000 amp., 6 volt plating generator set with complete control, synchronous motor drive, 440-3-60.

1—60 KW, 1500 amp., Anodizing M-G Set, 3 40 volts, any A.C. voltage, 3 ph., 60 cy. squirrel cage drive.

1—Electro-Products 120 KW, 3000 amp. Anodizing M-G Set, 3 40 volts, with complete control and synchronous motor drive.

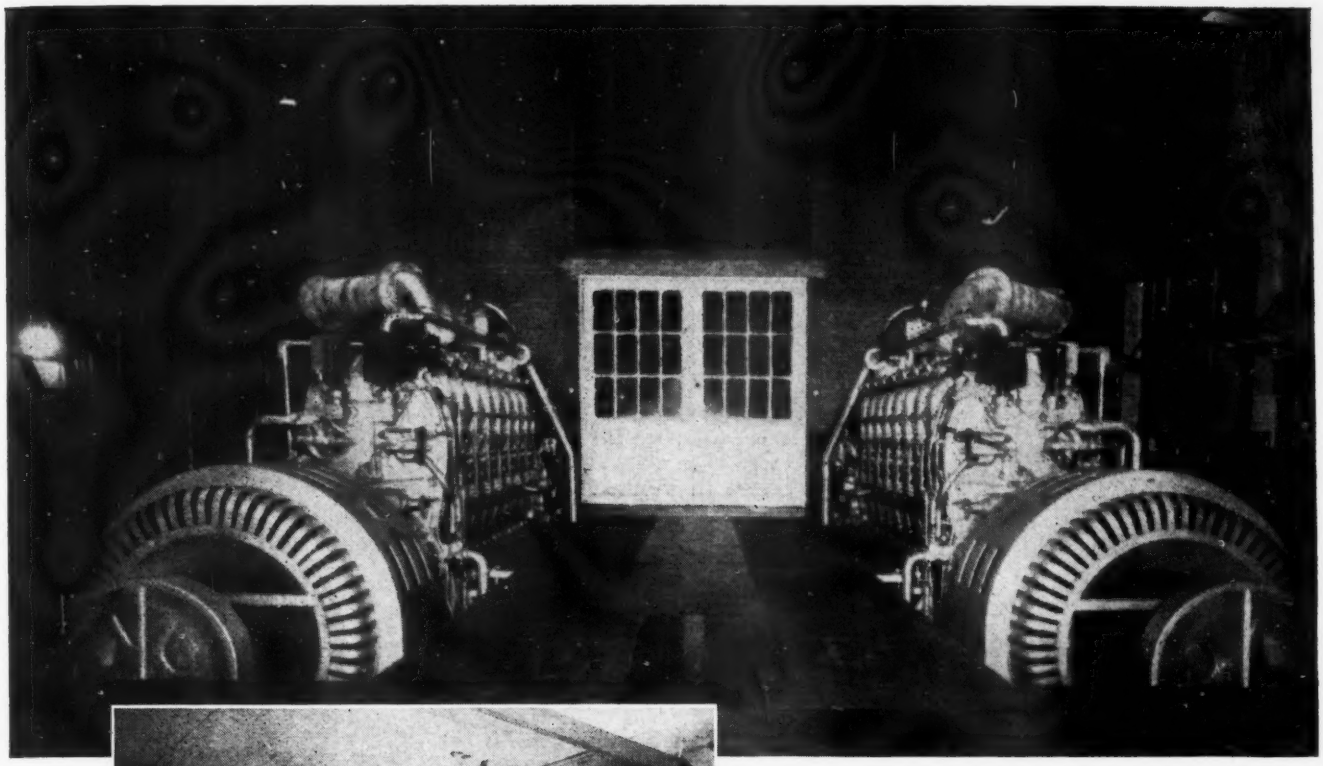
SPECIALS

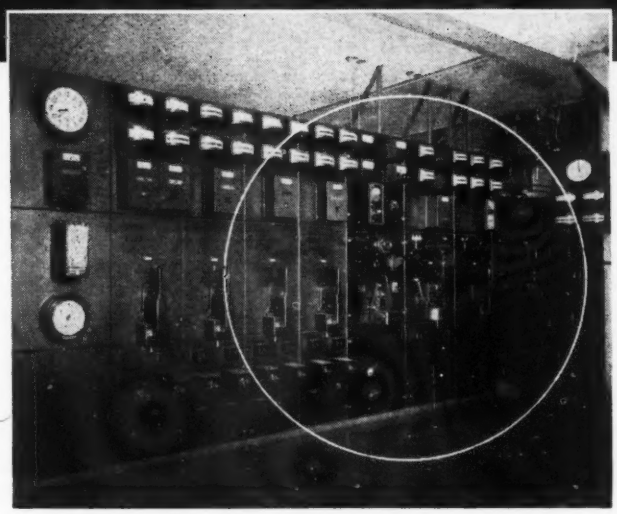
6—New Cutler-Hammer Bul. 9605, Size 3, 25 HP, 220-3-60, primary resistor type reduced voltage starters.

2—New Cutler-Hammer Bul. 9621, Size 5, 125 HP, 440-3-60 reduced voltage starters.

SPECIALIZING IN ELECTRICAL PROBLEMS OF THE RUBBER, METAL PROCESSING & MINING INDUSTRIES

The A-C SUPPLY Co.
(Formerly Electric Motor & Repair Co.)
Plant and Office Cuyahoga Falls, O.
P.O. Box 991, Akron 9, Ohio
Telephone (Akron) WAlbridge 1174





The two sets shown above were "Cusac Engineered" for a mid-western utility. Control switchgear, circled, was also installed. This complete installation can be seen by appointment.

"Cusac Engineered" means a complete, competent, dependable engineering service — from purchase of equipment to final approval. Cusac installations carry a new machine guarantee and are backed with a performance bond.

DIESEL ENGINE SETS

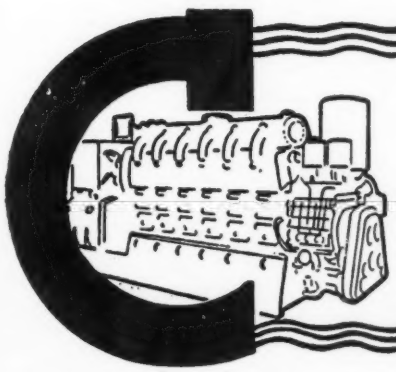
1600 H. P. GENERAL MOTORS · · ·

1600 H.P. GENERAL MOTORS, Model 16-278-A, 16 cylinder DIESEL ENGINE, bore 8¾", stroke 10½", RPM-720, direct connected to — NEW 1250 KVA IDEAL ELEC. and MFG. CO. Generator, 2400 volts, 3 phase, 60 cycle A. C. @ .8 p.f. BELTED EXCITER—New 10 K. W. IDEAL ELEC. & MFG. CO.

•

Five of these sets are available now.

•



F. L. CUSAC *and Associates Inc.*

DIESELS

WEBSTER 9-4180

BOARD of TRADE BLDG. — — CHICAGO

LEGAL NOTICE

Notice is hereby given that sealed bids will be received at the Office of the Clerk of the Board of Trustees of Public Affairs of the Village of Wellington in the Town Hall, Wellington, Ohio, until 12:00 o'clock noon on the 17th day of December, 1948, and then publicly opened and read, for the sale of the following personal property, F. O. B., Wellington, Ohio:

UNIT No. 1

USED installed 1940:

1 General Electric Turbo-Generator; Turbine No. 46400, 250 Lb. Steam Pressure, 655 degree total temperature, 2" absolute exhaust pressure, 9 stage, direct connected to

1 General Electric Generator; Alternating current, No. 5542459, Type ATB, 1250 KVA, 80% power factor, 3600 RPM. Form HL, 2400/4160 volt, 301/174 amp. 3 phase 60 cycle, direct connected to

1 D. C. Exciter No. 1778660 shunt wound, 125 volt, 120 amp, 15 KW.

1 Ingersoll-Rand Condenser, Serial No. 424 Size 11-12, Year 1940.

1 Ingersoll-Rand Jet Ejector, Serial No. 424 Year 1940, size 10-18 first stage, 15-8 2nd stage, 165 lb. gauge pressure, 473 degree total temperature.

1 Circulating pump, Cameron, No. 0940105, size 10 AFVS, 2250 GPM, 64 ft. head, 1600 RPM. Dual drive on common base with motor and steam turbine, direct connected to

1 G. E. Motor Induction type No. 5519260, 220/440 volt 3 phase 60 cycle, 1160 RPM, with G. E. Magnetic Starter CR 7006-D-31-B No. 4381261G3.

1 G. E. Turbine No. 46097 Type D-58-25, 1 stage, 50 HP. 1150 RPM. 375 lb. 250 degree superheat, 2 lb. back pressure.

1 Condensate Pump, Cameron, size 2½ DHW, 40 GPM, 1750 RPM. 159 ft. head No. 0940115, driven by and on common base.

1 G. E. Steam Turbine No. 46098 type D-57-20, 1 stage, 8 HP. 1750 RPM. 375 lb. steam pressure, 250 degree superheat, 2" back pressure.

1 Condensate Pump, Cameron, same as above, No. 0940116, driven by and on common base with

1 G. E. induction motor type 5-K-284 B2, 1740 RPM. No. AU-7604, 7½ HP. with G. E. Magnetic Starter Switch CR-7006-D-30-B, 220 volt, catalog No. 4381269G103.

1 Gauge Board, 61" wide, 96" high, 17" wings and steel roof, containing mounted

- 1 American Barometer.
- 1 American Mercury Vacuum Column.
- 1 G. E. Steam Pressure Gauge 6".
- 1 G. E. First Stage Steam Gauge 6".
- 1 Ashcroft Circulating Pump Suction Gauge, Compound.
- 1 Ashcroft Circulating Pump Discharge Gauge, Compound.
- 1 Ashcroft Stage Heater Recording 3 pen instrument.
- 1 Bailey Circ. Water Recording 3 pen instrument.
- 1 Bailey steam recording 3 pen instrument.
- 1 G. E. Temperature Indicating Instrument with Jacks.
- 1 G. E. Speed Indicator.
- 1 G. E. Telechrone Clock, 12".

2 Metal Clad Switch Panels, General Electric. Controlling excitation and fields to the above generator and 2400 volt 3 Phase current from the above generator to the bus, with the following instruments and switches.

Exciter panel:

1 D. C. Ammeter, 1—D. C. exciter Switch, 1—A. C. Field Control switch, 1—RPM. meter, 1—Rheostat control handle, 1—Polyphase recording kilowatt meter.

Generator panel:

1 3 point Ammeter, 1—A.C. indicating wattmeter, 1—A. C. Voltmeter, 1—DS 38 Polyphase watthour meter, 1—Power factor contacting switch, 1—Synchronizing switch, 1— Governor speed control switch.

100 ft. (Approx.) 6" steam feed line.

50 ft. (Approx.) 8" Exhaust line.

50 ft. (Approx.) 4" Condensate return line.

50 ft. (Approx.) 2" First stage return water line.

All present power, exciter, field and control wiring and cables, and auxiliaries with alarms, etc., as now equipped.

All the above items in unit No. 1 to be bid on where is and as is.

UNIT No. 2

USED installed about 1927:

1 General Electric Turbo-Generator: Turbine No. 37381, 165 lb. steam pressure, 6 stage direct connected to

1 G. E. Generator No. 4219197 Type ATB, 500 KW, 2300 V. 80% PF.

1 D. C. Exciter No. 663839, 9kw. 125 volts.

1 G. H. Wheeler surface condenser with circulating pump 1200 GPM, 45 ft. head, driven by

1 G. E. Induction Motor 220 volt, 48 amps, 1750 RPM.

1 Condensate pump 40 GPM, 1750 RPM, 73 ft. head, driven by

1 G. E. Motor 220/440 volt, 3 HP.

1 Condensate pump same as above driven by

1 G. E. Motor 220 Volt 3 HP.

1 Oil pressure pump duplex driven by steam reciprocating engine.

1 C. H. Wheeler Co. Air Ejector.

1 Triangular guage board, slate, containing 1—6" steam guage, 1— Horizontal Edgewise frequency meter, 2—Compound first stage pressure and vacuum guages.

Some steam, exhaust and condensate pipes from this machine to the nearest valve.

Some instruments that can be removed without interfering with other equipment and field resistance, exciter rheostat and switches that are now connected to this unit.

UNIT No. 3

USED installed about 1921:

1 General Electric Turbo-Generator Turbine No. 13942, 160 lb. steam pressure, 4 stage direct connected to

1 G. E. Generator No. 2005665, Type ATB, 500 KW, 2300 volt, 80% PF.

1 D. C. Exciter No. 663444, 8 KW, 125 volt.

1 Ministee Rotary Jet Condenser No. 4214, 28" Vacuum, 70 degree temperature, 11,-000 lbs. steam per hour, 690 RPM, driven by

1 General Electric Motor No. 1776739, 30 HP, 220 Volt, 385 RPM, 79A.

1 G. E. Starting compensator C. R. 1034, 220 Volt, 30 HP.

1 Triangular Slate Guage Board containing 1—G. E. Horizontal Edgewise Frequency Meter, 1—6" Steam Pressure Guage, 1—6" Vacuum Guage, 1—6" First Stage Compound Steam Gauge.

Some instruments that can be readily removed without interfering with other equipment; Field Resistance and exciter rheostat and switches that are now connected with this generator

Approximately 10 feet of 5 or 6" steel steam pipe.

UNIT No. 4

NEW not installed:

1 Heavy Duty Type "E" Stoker, Combustion Engineering Co. Length 9'4", width 8'6", total area 79.34 sq. ft.

UNIT No. 5

NEW not installed:

1 Heavy Duty Type "E" Stoker, Combustion Engineering Co., Length 9'4", width 8'6", total area 79.34 sq ft.

All the above equipment to be removed by purchaser, the city will allow the walls to be opened for removal and will replace walls, with the exception of the two panels of switchboard, the city will remove these from present position and place them on our floor where they can be picked up by purchaser.

The bidder to carry Public Liability Insurance, Indemnity Insurance, Certificate that they are protecting their employees, and that they are complying with all state and local laws applying to this type of work, and protect the city from any liability or damages that might accrue from the removal of this equipment.

All of the above constitutes property of the Village of Wellington, Ohio, not required for municipal purposes and authorized to be sold by Council of the Village of Wellington, Ohio.

Bids may be submitted for one or more units.

Each bid must contain the full name of each person or company interested in bidding on the same and be accompanied by a certified check on some solvent bank in the sum of not less than ten percent of the bid as a guarantee that if the bid is accepted a contract will be entered into and its performance properly secured. Should any bid be rejected such check will be forthwith returned to the bidder, and should any bid be accepted such check will be returned upon the proper execution and securing of the contract.

Said property to be sold and conveyed to the highest bidder by bill of sale on the following terms: Cash on day of sale.

Further information concerning the above can be secured from the Clerk of the Board of Trustees of Public Affairs.

The right is reserved to reject any and all bids.

By order of the Board of Trustees of Public Affairs, Wellington, Ohio.

Robert S. Foster, President

John T. Duff, Clerk 42-5c

TRANSFORMERS

FOR SALE

3— 3 KVA W-H 13200-120/240
12— 5 KVA W-H 13200-120/240
4— 10 KVA W-H 13200-120/240
1— 15 KVA W-H 13200-120/240
3— 25 KVA W-H 13200-120/240
3— 25 KVA Mol 13200-120/240
10—37½ KVA W-H 13200-120/240
2— 25 KVA W-H 13200-2400
2—37½ KVA Mol 13200-2400/4160Y
3— 75 KVA W-H 13200-120/240
3— 75 KVA G-E 13200-120/240
1— 75 KVA Mol 13200-2400
1— 100 KVA W-H 13200-2400
10— 1½ KVA Wag 7200-120/240 "REA"
2— 5 KVA G-E 4800-120/240
4— 5 KVA W-H 2400/4800-120/240
4— 7½ KVA W-H 4800/8320Y-120/240
1— 25 KVA Mol 2400/4800-120/240
3— 50 KVA W-H 4800/8320Y-120/240
3— 50 KVA G-E 26400-2300/4000Y
3— 50 KVA G-E 33000-2400/4160Y
3— 100 KVA G-E 33000-2400/4160Y
3— 200 KVA Pitts 26400-2300/4000Y

TRANSFORMERS

WANTED

Rewind and repair service on all makes of transformers.

THE ELECTRIC SERVICE CO.
Cincinnati 27, Ohio

MOTOR GENERATORS

500 KW G.E. SYN. 250 V. 440/2300/4000 A.C. 3 PH. 60 CY. 900 RPM.

500 KW G.E. SYN. 600 V. 2300/4000 A.C. 3 PH. 60 CY. 900 RPM.

400 KW WEST. SYN. 600 V. 2300/4000 A.C. 3 PH. 60 CY. 720 RPM.

300 KW G.E. SYN. 250 V. 2300/4600 V. A.C. 3 PH. 60 CY. 1200 RPM.

150 KW G.E. SYN. 250 V. 2300/4000 V. A.C. 3 PH. 60 CY. 1200 RPM.

150 KW RIDGWAY SYN. 250 V. 2300 V. A.C. 3 PH. 60 CY. 1200 RPM.

SYNCH. CONVERTER

300 KW G.E. 600 V. D.C. 6 PH. 60 CY. 1200 RPM 2300/4000 V. TRANSFORMERS

Each unit listed above is owned by us and is available now for immediate purchase.

WALLACE E. KIRK COMPANY
502 Grant Building, Pittsburgh, Pa.

DIESEL-GENERATORS

5 KW. TO 1000 KW.
NEW-USED
RECONDITIONED

J. PARKER THOMPSON CO., INC.
507 FIFTH AVE., NEW YORK 17, N. Y.
MURRAY HILL 7-6547

ELECTRICAL EQUIPMENT — REBUILT and GUARANTEED

MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

PROMPT SHIPMENT—PARTIAL LISTING

SLIP RING MOTORS—3 Ph., 60 Cy.

Qu.	H.P.	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-5201
1	7½	575	220	G.E.	MT-522
2	10	1140	440	West.	HF-7A
2	10	570	220	G.E.	HI-11
2	11‡	810	550	G.E.	ITC-5008
2	15	1160	440	West.	CW-464C
2	15	570	220	West.	CW-646
1	18	680	440	West.	NW-316
1	20	860	440	West.	CW-638
1	25	1130	550	G.E.	MT-323
2	25	850	220	Wagner	BR
2	25	720	440	Wagner	22VBR
1	30	1130	440	G.E.	MT-326
1	30	865	440	West.	CW-646
1	30	850	440	G.E.	MT-332
1	30	675	440	G.E.	MT-336
2	35	900	440	F-M	HV-H16A
2	40	865	2200	Al.-Ch.	ARY-223C
1	40	560	440	G.E.	MT-346
2	50	1150	440	G.E.	M-536
1	50	869	440	West.	HF-12A
1	50	570	440	G.E.	MT-552
5	52‡	550	220	G.E.	IQC-5013***
1	60	685	440	West.	CW-758
1	60	570	550	G.E.	MTC-5546
1	60	345	550	West.	CW
1	75	720	550	G.E.	MT-556
1	80‡	575	440	G.E.	MTC-5352
1	100	690	440	G.E.	MTC-5552
2	125	430	440	G.E.	IL-16
2	150	1750	440	G.E.	MTP-549
1	175	505	550	West.	CW-1002
2	200	600	550	G.E.	IM-17
1	200	495	2200	G.E.	IM-17A
2	250**	296	220/380††	West	CW-20-53-15
3	300	900	140	G.E.	IM-17
2	300	880	2200	G.E.	IM-17A
2	300**	360	440	West.	CW-20-53-15
2	350	880	2200	G.E.	IM-17A
1	400	505	550	West.	CW
1	650**	360	440	G.E.	MT-442Y
1	700	735	4000‡‡	West.	CW

All 220 volt motors can be reconnected for 440 volts.
‡ Intermittent rating. *** 2 phase.
** New. †† 50 Cycle. ‡‡ 25 Cycle.

230 Volt Constant Speed D.C. Motors

Qu.	H.P.	Speed	Make	Type
22	2	850	West.	SK-20
20	3	1150	West.	SK-20
10	3	850	Reliance	Y-23T
25	3½	850	West.	SK-30
3	7½	1750/1310	West.	SK-43
2	7½	1150	G.E.	CDM-66
3	7½	850	G.E.	CD-75
10	10**	1750	Kimble	BA-324
5	10**	1150	Al.-Ch.	EB-80
1	10	850	West.	SK-83
10	13½**	600	West.	SK-93
3	15	1750	G.E.	CD-75
5	15	825	West.	SK-90
1	20	1750	L.A.	ONA-L851
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
11	20	750	West.	SK-1101
17	25	825	West.	SK-120
2	30	1100	G.E.	RC-12
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-150
1	50	650	G.E.	RC-16
2	60	1750–1310	West.	SK-143
3	75	850	West.	SK-160
1	150	700	Al.-Ch.	
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D.C. MOTORS

10	1½/2	500/200	G.E.	CD-65
1	2	225/900	Reliance	78T
1	5	450/1800	G.E.	CD-83
2	6	450/1800	G.E.	RF-9
6	5/7½	600/1800	G.E.	RA-30
1	10	400/1600	Reliance	T-92T
1	12½	280/840	West.	SK-130
10	12½**	600	West.	SK-93
1	15	600/1200	West.	SK-100L
1	20	500/1500	G.E.	RF-11
1	20/25	400/1600	Reliance	T-230-T
1	20/25	300/1200	West.	SK-153
1	25	500/1500	G.E.	RF-12
1	23/29	300/1200	G.E.	RF-13
1	30	400/1200	West.	SK-163
1	30/40**	400/1600	G.E.	CD-1236
1	35	500/1500	West.	SK-143
1	40/50	400/1600	Al.-Ch.	ED-147
1	75	500/1500	Cr.-Wh.	CCM
1	75	375/750	Cr.-Wh.	CMC-125H
3	100	225/900	G.E.	MPC-A
5	100	400/1200	Al.-Ch.	
1	100	320/960	West.	SK-200
1	175	230/500	West.	SK-220
2	375	350/500	G.E.	MPC

** New.

VARIABLE VOLTAGE DRIVES

40 HP. Reliance, Variable Voltage Drives, each Consisting of:
1—40 KW 250 Volt, Induction M-G Set, with two auxiliary 5 KW generators and exciter.
1—40 HP 400/1500 RPM, Frame 385T, 230 Volt, DC Motor.
With full magnetic control providing jog forward, jog reverse, run, fast, slow, and stop, and motor operated field rheostat.

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.
Totally Enclosed Fan Cooled, Ball Bearing

Qu.	H.P.	RPM	Volts	Make	Type & Frame
2	½	1750	220	R&M (TE)	L-184
1	½	1725	440	G.E.	K-63
4	1	1140	220	Howell	A-204
4	1.5	1150	220	L.A. (TE)	IS-225
5	1.5	1140	440	West.	CS-225
1	2	1735	220	G.E.	K-224
4	2	1140	220	L.A.	JS-225Y
1	2	1100	440	West.	CS-225
1	3	3450	220	Howell	K-224
3	3	1160	440	L.A.	JS-254
1	5	3480	220	G.E.	K-225
2	5	1750	440	L.A.	JA-254
10	5	1730	440	G.E.	K-254
1	5	1720	440	Century	SCH-254
2	5	1165	440	L.A.	JA-284
5	7.5	1740	440	G.E.	K-284
1	7.5	1735	220	G.E.	KF-284
1	10	3480	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	10**	880	220	West.	CS-365-EXPF
1	15	1745	440	West.	CS-326
1	15	1175	440	L.A.	JA-365
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504

Splashproof, Ball Bearing

1	2	1735	440	G.E.	K-224
1	3	1160	440	L.A.	FS-254
23	5	1750	440	L.A.	FS-254
1	5	1735	220	G.E.	K-254
1	5	1160	440	L.A.	FX-284
1	10	3480	440	G.E.	K-284
1	15	1175	440	L.A.	JA-365
4	15	1150	440	L.A.	FX-365
3	30	3520	440	L.A.	FX-365S
2	40	1175	220	G.E.	K-445
3	50	1760	440	L.A.	FX-445A
5	50	1160	220	G.E.	K-504
1	125	1770	440	L.A.	FX-107SY
1	150	1775	440	L.A.	FX-116S
3	150	880	440	L.A.	FX-136S
1	150	700	440	G.E.	KF-6335
1	200	885	440	L.A.	FS-137S

Open Type Motors

Qu.	H.P.	Speed	Volts	Make	Type
5	2	170	440	G.E.	KT-926
4	2	1160	440	West.	CS-93C
1	2	690	440	G.E.	KT-944
10	5	1740	440	West.	CS-232C
1	7½	3475	440	West.	CS [illegible]
1	7½	1750	440	West.	CS-250C
3	7½	1165	440	G.E.	KT-952
2	7½	870	440	West.	CS-370C
5	10**	1760	440	L.A.	OGA-324
5	10**	1750	440	West.	CSP-324
3	10	1160	440	West.	CS-370C
1	10	865	440	G.E.	KT-502
1	15	3485	220	Reliance	AA-B3247
5	15**	1735	440	Century	SC326
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
5	20**	1750	440	Wagner	RPI-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KF-512
2	20	900	220	G.E.	FTR-522
1	25	1800	220	G.E.	KT-312
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	900	220	Howell	SCRB-356***
2	25	575	440	G.E.	KT-542
1	30	1160	440	West.	CS-644
1	30	870	220	West.	CS-646
1	40**	3545	220	G.E.	KF-404S
3	40	1750	440	West.	CS-583C
2	40	900	2300	G.E.	FTR-536
4	50**	1750	440	Wagner	RP5-405
1	50	850	220	West.	CCL
2	60**	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-346
1	75	1160	440	West.	CS-662C
1	75	870	220	West.	CS-766A
1	100	690	220	West.	C [illegible]
1	100	580	2200	G.E.	IK-15A
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.-Ch.	AN
2	125	435	440	Al.-Ch.	AR
2	125	400	2300	G.E.	I-17-FR
2	200	580	550‡‡	G.E.	KT-566S
1	500	1200	440	G.E.	KTP-567
1	700	1800	2300/4000	West.	CS-4-39D-12

All 220 volt motors can be reconnected for 440 volts.
** New. *** 2 Phase.
‡‡ Reconnectable for 440 volts.

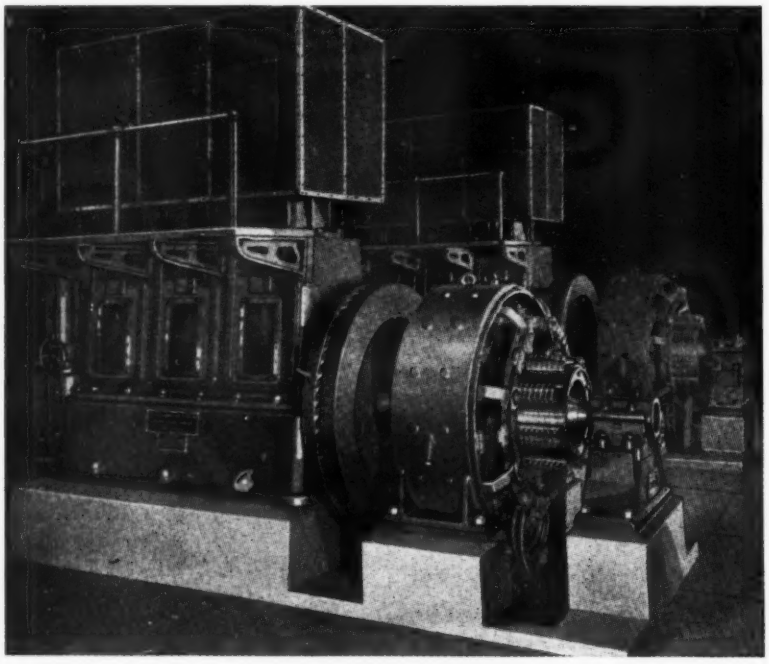
CRANE, MILL TYPE, 230 V. D.C. MOTORS

Qu.	H.P.	Speed	Make	Type
2 (115 v.)	3½	700	G.E.	CO-1803
2	5½	760	West.	MCB-20
1	6½	680	West.	K-3
1 (new)	6/ 7	1050/900	West.	K-2
1 (new)	10	650	G.E.	MD-403-BE
1 (new)	20/25	975/875	West.	K-5
1 (new)	20/25	515/460	West.	K-6
3	25	590	Diehl	TE
2	27½	535	West.	K-7
2	35	750	G.E.	CO-1828
3 (new)	35	600	West.	CK-9
1	50	750	G.E.	CO-1829A
1	50	600	West.	CK-9
5 (new)	50	525	G.E.	COM-1830AE
4	50	525	G.E.	CO-1830
1	50	470	G.E.	CO-2007
2 (new)	60	550	G.E.	COM-1831 AE

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment Is Located in Our Cleveland Warehouse. We Have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.
4521 HAMILTON AVE. CLEVELAND 14, OHIO

ATTRACTIVE OFFERING



ACTUAL VIEW OF INSTALLATION

800 KW capacity

250 volt direct current

POWER PLANT

AVAILABLE IMMEDIATE DELIVERY

2—400 KW, 40° General Electric 1600 Amp. 2-wire, 250 volts, 360 RPM Type LDR, Form A, compound wound interpole direct current generators direct connected to:

2—640 HP Skinner Vertical 360 RPM, 3 cylinders, 15" diameter by 14" stroke right-hand Unaflow non-condensing engines, operated at 140 to 160 P.S.I.G. 0 to 10 lbs. gauge back pressure and designed for a maximum of 185 P.S.I.G., 15 to 20 lbs. gauge back pressure.

Complete with all appurtenances to engines including generator operating panels.
This is a rare opportunity to acquire an exceptionally fine generating plant at a substantial saving from cost new.

UTILITIES ELECTRICAL MACHINERY CORPORATION

600 NATIONAL CITY BANK BLDG. *Long Distance Phone 422* CLEVELAND 14, OHIO

TURBO GENERATORS

TURBINE OF THE MONTH

1—5000 KW. 6250 KVA. Gen. Elec. 3600 RPM 175/200 lbs. I.S.P., 100° SH. Condensing 3 ph 60 cyc., 2300/4000 volts surface condenser and all auxiliaries.

1—2000 KW G.E. 6600v, 3 ph., 60 cy. with 175 lb. cond. turbine and dir. conn. exciter.

1—1500 KW Westg. 400#, 700°F, condensing 3 ph, 60 cy. 2400 V. Surface condenser.

1—450 KW Whse 250 lbs. I.S.P. Surface Condensers—Auxiliaries—3 phase, 60 Cycle, 400 Volts. Direct connected Exciter Equipment built 1944.

2—1250 KW G.E. 2300v, 3 ph. 60 cy. with 175 lbs. condensing turbine

1—1250 KW Al Ch. 2300v, 3 ph., 60 cy. with 200 lb. condensing turbine surface condenser.

1—1000 KW G.E. 2300/4150v, 3 ph., 60 cy. with 135/150 lb. condensing turbine.

1—500 KW G.E. 480v, 3 ph., 60 cy. dir. conn. exciter with 80/100 lbs. I.S.P. 10/15 lbs. B.P., non-condensing turbine.

2—500 KW G.E. 2400 v, 3 ph., 60 cy. dir. conn. exciter, 175 lbs. I.S.P. 10/15 lbs. B.P. non-cond.

BELYEA COMPANY INC.

43 HOWELL ST. JERSEY CITY 6, N. J.

Phone—Journal Square 2-3334

ALSO N. Y. CITY LINE—RECTOR 2-7150

TRANSFORMERS

4—75 KVA., Single Phase, 60 Cycle, General Electric, Type H, Form KR, 13200/12540/11880-440 volts, #4999501-03-05 & 07.

3—37½ KVA., Single Phase, 60 Cycle, General Electric, Type H., Form KG, 13800/13110/12420-230/115 volts, #5512044, 5512042 & 5514263.

3—25 KVA., Single Phase, 60 Cycle, General Electric, Type H., Form KR., 13800/13110/12420/230/460 volts, #4835052, 4790944 & 4835056.

1—200 KVA., 3 Ph., 60 Cy., Gen. Elec. PYRANOL, Type HT, 575-230 Volts, #5597297.

All the above transformers are ready for immediate delivery.

ARCHER & BALDWIN, INC.

(Inc. 1917)
75 West Street, New York City 6, N. Y.
Tel.—BOwling Green 9-9275—9276

STEEL STORAGE TANKS

6—74.000 & 35.000 Bbl. Vertical
2—10.000 & 3—3.000 Bbl. Vertical
6—10.000 & 3—20.000 Gal. Horizontal

DARIEN CORP.,
60 E. 42nd St., N. Y., N Y

Complete dead front slate switch-board

3300 KW, 2300 volt. 14 street lighting, distribution and generating panels.

For information write

BOROUGH OF GROVE CITY,
Grove City, Pennsylvania

BOILERS

10 to 1000 H. P.

NEW-USED RECONDITIONED

Steam, Gas and Electric Power Equipment

J. PARKER THOMPSON CO., INC.
507 FIFTH AVE., NEW YORK CITY
MURRAY HILL 7-6547-8-9

MOTORS • GENERATORS • TRANSFORMERS

MOTORS
3 PHASE—25 CYCLE—220/440 VOLTS

H.P.	Make	Type	Frame	RPM
50	Fairbanks Morse	H16B	Ball Bearing	750
75	Fairbanks Morse	H16C	B.B. Slipring	750
75	Gen. Elect.	IK	2200 volt	750
75	Gen. Elect.	IK		1500
100	Allis Chalmers			1450
150	Gen. Elect.	IK-17		365
150	Gen. Elect.	IK-16		480
150	Gen. Elect.	IM-16	Slip Ring	480
150	Allis Chalmers			1450
150	Gen. Elect.	KT	557	1155
400	Gen Elect.	IM 17A	Slip Ring	730
500	Gen. Elect.	IK		485
600	Gen. Elect.	MT	Slip Ring	490
600	Westinghouse	CS		490

NEW TRANSFORMERS

6—50 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—75 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—100 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
3—100 KVA Niagara O.I.S.C. 2400/120/240 1 Phase 60 cycle with taps.
3—150 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.
6—200 KVA Niagara O.I.S.C. 2400/240/480 1 Phase 60 cycle with taps.

REBUILT TRANSFORMERS

Qu.	KVA	Make	Cycle	Voltage
3	15	Wagner	25	4400/240/480
3	50	Pitts.	25	11000/2300
2	50	Kuhlman	25	11500/2300/230/460
1	50	Kuhlman	25	11500/115/230
2	50	G. E.	60	2400/120/2400
1	100	G. E.	25	4600/230/460
3	400	Pitts.	25	12000/110

FREQUENCY CHANGERS
All Sizes in Stock, 60 cycle to 90 cycle, 100 cycle, 120 cycle, 180 and any other high cycle if desired.

HORIZONTAL & DUPLEX
Compressor & Vacuum Pumps after Coolers, Filters

25 CYCLE MOTORS

1—1270 HP. Gen. Elect. Synchronous Motor Type A.T.I. 3/25/2200 Volts 150 RPM.
1—1900 HP. Gen. Elect. Synchronous Motor Type A.T.I. 3/25/2200 Volts 150 RPM.

MOTOR GENERATOR SETS

2—350 KW General Electric Sets 250 Volts D.C. driven by 500 HP. 3 Phase 25 Cycle motors —Will rewind for 60 Cycle operation.

ROTARY CONVERTERS

1—2000 KW Westinghouse Booster type Rotary Converter 230 Volt D.C.—3 to 6 Phase, 25 Cycle, 4600 Volt Transformer.
2—2500 KW Gen. Elect. Synchronous Converters, 270 Volt D.C.—Transformer 3 Phase, 25 Cycle, 11,000 volts.
2—3500 KW Gen. Elect. Synchronous Converters, 270 Volt D.C.—Transformers 3 Phase, 25 Cycle, 11,000 volts.

COMPENSATORS

1—40 HP Gen Elect New Type CR. 1034-K1 3/60/220 Volts.
1—50 HP Gen Elect New Type CR 1034-KI 3/60/220 Volts
2—75 HP Gen Elect New Type CR. 1034-KI 3/60/220 Volts.

NEW MOTORS
300 New Gen. Elect. & Westinghouse Motors in stock from 1 to 100 H.P.

75 KW. FREQUENCY CHANGER
75 KW. Gen. Electric Frequency Changer. 3 phase 120 Cycle 220/440 Volts—direct driven by 60 HP. Motor 3/60/220/440 volts.

MOTORS

1—75 HP. Fynn-Weischel Synn. 3/60/440/1200 RPM.
1—100 Gen. Elect. Slipring Type I Form M., 3/60/440/900 RPM.
1—100 HP. Gen. Elect. Type K (New Motor) 3/60/440/1800 RPM.
1—100 HP Westinghouse Slipring Type CW, 3/60/440/435 RPM.
1—100 HP. West. Slipring Type CW 3/60/440/1200 RPM.
1—100 HP. Gen. Elect. Slipring 3/60/440/1200 RPM.
1—200 Gen. Elect. Type KT. 572 3/60/440/600 RPM.
1—200 HP. Gen. Elect. Slipring Type I Form M. 3/25/440/500 RPM.
1—500 HP. Allis Ch. Slipring 3/60/2200/514 RPM.
1—500 HP. Gen. Elect. Type I Form K. 3/25/440/485 RPM.
1—600 HP. West. Motor Type CS, 3/25/550/490 RPM.
1—600 HP. Gen. Elect. Slipring Type MT. 3/25/550/490 RPM.

VARIABLE SPEED MOTORS

2—300/150 HP. General Electric Motors Type BTA.—3 Phase 60 cycle 440 volts 560/280 RPM with controls.

3 PHASE 550 VOLTS 25 CYCLE MOTORS
Write for our stock list of approximately 500—3/25/550 Voltmotors

ERIE ELECTRIC CO., INC. 124 CHURCH ST. BUFFALO, N. Y. CL. 4758

WE OWN FOR IMMEDIATE DELIVERY

GAS PURIFICATION SYSTEM
Complete with tanks, valves, piping. Capacity 2,000 cu. ft. per hour.

BLOWERS
4—18000 CFM 7¾" SP, V-Belted Type SE, No. 12 American.
6—10000 CFM 1.9" SP, Everdur Blades, Type R. Buffalo.
1—5750 CFM 7½" SP, American.
3—3300 CFM ¾" SP with Motors.
6—1200 CFM 13.9" SP with Motors.
3—1000 CFM ⅜" SP with Motors.

BOILER PLANT
Complete plant, Erie City, 604 HP, 180 PSI, ASME code and Natl. Board. Pulverized coal fired, with coal bin bucket elevator.

PUMPS
Chicago 4"x4" 500 GPM 88' H., C.I.
Allis Chalmers 2½" x 2" 200 GPM 140' H.
F.M. 3"x3" 300 GPM 100' H.
Deming, bronze 3"x2" 150 GPM 50' H.
Duriron 4"x3" 290 GPM, 90' H.
Duriron 3"x2" 300 GPM 108' H.
Wilfley S.S. 3"x2½" 150 GPM 100' H.

WELDERS
300 and 400 amps. G. E. and Hobart 3/60/220/440, rebuilt & guaranteed. New 1943. (200 available).

AIR CONDITIONING UNITS
2—NEW CHRYSLER AIRTEMP units 75 ton complete with Trane Evaporative Condensers, Fans and Motors.
1—20 ton, Frigidaire

BUCKET ELEVATORS
28' centers, single chain 188, 8"x5" MI Buckets, steel encased.
46' centers, single 3½"x6" pitch chain, 7"x5" Buckets, steel encased with drive.
48' centers, single 825 chain, 14"x7" MI Buckets, steel encased.
68' centers, single 825 chain, 10"x6" MI Buckets, steel encased.

MOTORS
Large quantity NEW Gear Motors and X.P. from ½-75 H.P. available immediately.

DIESEL LOCOMOTIVE
Diesel Electric Locomotive, G. E. 45 ton, standard gauge with two 150 HP Cummins Engines. New 1940. Rebuilt.

DIESEL GENERATOR SETS

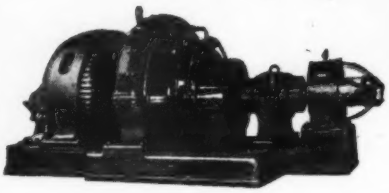
3—G.M. Model 6-71RC, 1200 RPM, 6 cylinders, direct connected to 75 KVA Generators 3/60/127-220, complete. New 1945. Only used 100 Hours. Guaranteed condition

3—G. M. Model 8-268A, 1200 RPM, 8 cyl., direct connected to 300KW D.C. Generators 120/240, comp. New 1942-3.
1—G. M. Model 3-268A, 1200 RPM, 3 cyl. direct connected to 100KW D.C. Generators 120/240, comp. New 1942-3.
5—Superior Model GDB-8, 1200 RPM, 8 cyl., direct connected to 100KW D.C. Generators 120/240, comp. New 1942-3.

TRANSFORMERS
10 KVA G.E. 2400-240/480
25 KVA West. 450-117 air cooled. (10)
37½ KVA G.E. 4600-2300 (3 avail.).
100 KVA West. 4160-208/120, 3 phase.
200 KVA G. E. Pyranol 2400-4160Y/240-120.
200 KVA G. E. Pyranol 2400-4160Y/240-480.
500 KVA West. 4160-480.

Heat and Power Co., inc.
70 PINE STREET | DIGBY 8-0373 | NEW YORK 5, N. Y.

REBUILT BY CHICAGO ELECTRIC



Fine Items From One of The Nation's Largest Stocks Of Motor Generator Sets
Check These Units For Service, Economy and Prompt Delivery

Special Offering

MOTOR GENERATOR SETS

1000 KW generator, General Electric type MPC, compound interpole, 275 volts, 514 RPM, direct connected to, 1120 KVA synchronous motor, General Electric, type TS, 3 phase, 60 cycle, 4600 volt, 514 RPM, on fabricated steel sub-base. Complete.

500 KW generator General Electric, type MPC, compound interpole, 250 volts, 720 RPM, direct connected to, 710 HP synchronous motor, General Electric, Type ATI 3 phase, 60 cycle, 440 volts, 720 RPM, 3 bearing unit, on fab. steel sub-base.

TWO COMPLETE VARIABLE VOLTAGE DRIVES

Motor Generator Set—

200 KW DC generator, General Electric, type MPC 250 volts, 800 amps, 1200 RPM, direct connected to, 300 HP synchronous motor, General Electric, type TS, 3 phase, 60 cycle, 440 volts, .8 P.F. 1200 RPM.

D.C. Motor—

250 HP General Electric, type MPC, form A, 245 volts, 730/975 RPM. Complete Starting and Control Panels.

MOTOR GENERATOR SETS

KW	Make	AC Volts	DC Volts
1250	Al. Chlrs.	4000	550/600
1000	Gen. Elec.	4150	250/275
500	Gen. Elec.	2300/4000	600
500	Gen. Elec.	440	250
450	Gen. Elec.	2300	125
350	G.E.	440/2300	250
350	G.E.	2400	250
300	Gen. Elec.	440/2300	250
300	Gen. Elec.	2400	250
200	Cr. Whlr.	2300	125
150	Al. Chlrs.	220	125
90	Gen. Elec.	2300	60
75	Star	220/440	230
75	Gen. Elec.	2300	125
75	Wstghse.	2300	110
75	Gen. Elec.	2300	250
60	Al. Chlrs.	2300	110
60	F. Morse	220	125
50	Wstghse.	220	110
50	Cr. Whlr.	240	230
40	Cr. Whlr.	220	125
40	Wstghse.	220	125
40	Cr. Whlr.	440	125
35	Gen. Elec.	220	40
25	Wotton	220	97/111
20	Bogue	220/440	125
15	Columbia	440	45
15	Wstghse.	220	250
10	Reliance	440	250
10	Cr. Whlr.	220	125
8	Hertner	220	90/108
7½	Milwaukee	44	60
6	Gen. Elec.	220	230
5.25	Wstghse.	220	115
5	Cr. Whlr.	220	115
5	Ideal	220	115/230
5	Hertner	220	90/108

SQUIRREL CAGE MOTORS

HP	Make	Type	Volts	Speed
400	Wstghse.		2200	1750
350	Gen. Elec.		440	720
250	Wstghse.	CS	2200	1800
200	Al. Chlrs.	New	440	900
150	Al. Chlrs	AR	440	1750
125	Gen. Elec.	TEFC	440	1200
100	Al. Chlrs.	AR	440	514
75	A.C.	AR	220/440	1800

D. C. MOTORS

HP	Make	Type	Volts	Speed
100	Gen. Elec.	RC	220	2500
100	Wstghse.	SK	230	625
75	Wstghse.	SK	230	850
60	Gen. Elec.	CD	550	1000

SLIPRING MOTORS

HP	Make	Type	Volts	Speed
3000	Gen. Elec.		2200	120
800	Wstghse.	CW	6600	507
600	Gen. Elec.	IM	440	382
400	Wstghse.	CW	2200	450
350	Gen. Elec.	IM	2200	720
300	Gen. Elec.	IM	440	900
200	Gen. Elec.	IM	2300/440	600
150	Gen. Elec.	IM	440	450
75	Gen. Elec.	IM	440	720

SYNCHRONOUS MOTORS

HP	Make	Type	Volts	Speed
1080	Wstghse.	25 cy.	6600	750
1000	Gen. Elec.	TS	2400	900
1000	Wstghse.		440	900
300	Al. Chlrs.		4000/2300	600
250	Al. Chlrs.		2200	720
210	Elec. Mach.		440	900
200	Al. Chlrs.		2300	360
200	Al. Chlrs.		440	360

Remember! This Is Only A Partial Listing From Our Large Quality Stocks. We Can Furnish You With Almost Any Item in the Electrical Power Equipment Field . . . . And Then Some

CHICAGO ELECTRIC COMPANY

1320 WEST CERMAK ROAD — CHICAGO 8, ILL. — CANAL 2900

WURTH for "WORTH"!

A. C. GENERATORS

3 PHASE—1 PHASE 15 to 62½ KVA

LARGEST STOCK OF A.C. AND D.C. MOTORS

FROM 5 TO 200 H.P.

D.C. MOTOR GENERATOR SETS TO 75 KW

HIGH CYCLE GENERATORS

Send For Our Latest Stock List

WURTH ELECTRIC MOTOR COMPANY

Motors, Generators, Alternators F q ency C

141 GRAND ST. — CAnal 6 6135 — NEW YORK CITY

GENERATOR SETS

100 KW 200 KW

General Diesel Engines
8 cylinder Model 8-268A
6½" Bore x 7" Stroke

Direct connected to:

200 K. W. WESTINGHOUSE ALTERNATORS

3 phase, 50 and 60 cycle, 400/440 V., Inc. Switchboards. Also—
3 Cylinders General Motors Diesel Engines Sets:

Direct Connected to:

100 KW CENTURY ALTERNATORS

3 Ph., 60 cy., 440 Volt Inc. Switchboards

LATEST MODEL IMMEDIATE SHIPMENT

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Sterling 3-6515

TURBO-GENERATORS

200 KW. TO 5000 KW.

NEW-USED RECONDITIONED

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MURRAY HILL 7-6547

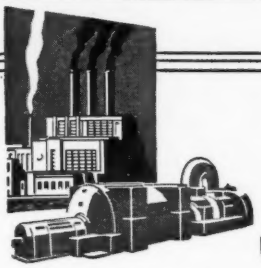
FOR SALE

Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINERY COMPANY
Jackson, Miss.

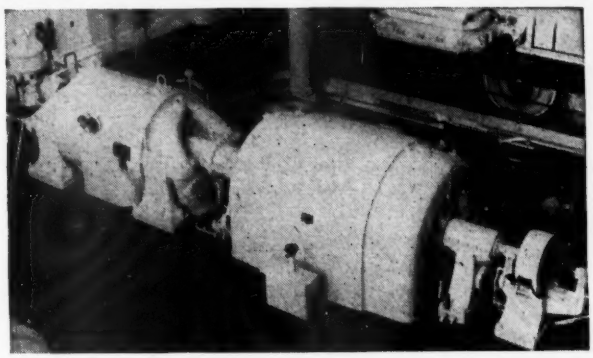
50,000 lb. Integral Furnace 400 lb. B & W boiler superheater air heater pulverizer fans accessories
2500 KW 2400 volt GE Cond. turbine unit
1500 KW 480 volt GE NonCond Turbine set.
283 KVA 240 volt Chuse Uniflow engine set.
200 KVA 480 volt Ridgway 4 valve engine set.
200 KW G. E. M. G. Set 2200 AC 250 DC
50 KW G. E. M. G. Set 220/440 AC 250 DC.

HOWARD B. JOHNSON & ASSOCIATES
53 W. Jackson Blvd. Chicago 4, Ill.



SPECIAL

TURBO GENERATOR
6000 KW
UNITY POWER FACTOR



OUTLINE DATA ISP 240#, 560° F total temperature, condensing, 60 cycle, 3 phase, 2400 volts. Surface condenser, panel board, meters, breakers, pumps, complete auxiliaries.
TURBINE Westinghouse semi-double flow, 6000 KW. Rebuilt 1922 by Westinghouse with steel parts for this rating and steam conditions indicated. Spring, 1948, complete overhaul. 1800 RPM. Originally manufactured 1912.
GENERATOR 6000 KVA. 2400 volts, 1443 amperes. April, 1948: Field removed, field and stator thoroughly cleaned and sprayed, generator overhauled. 50 KW shaft exciter.
CONDENSER 13,000 foot, Worthington surface condenser, with pumps, air ejector, etc. Radojet with inter condenser.
AUXILIARIES Complete and standby provided for most.

TURBO GENERATORS

ITEM 601 — Built 1922
300KW Non-condensing. 200# ISP. 20# GBP. 480 Volt.

ITEM 1769 — Built 1931
625 KW Wemco non-condensing. 125# (good for 400# 700°). 2400 Volt.

ITEM 62 — Built 1927—Rebuilt, rewound 1941
300 KW Wemco condensing. 150#. 60/3/120-208 Volt. Excellent.

ITEM 602 — Completely reconditioned.
2000 KW G. E. condensing. 165#. 2400 Volt. New 3rd wheel. Utility maintenance.

ITEM 908 — Reconditioned—rewound
5000 KW, G. E. condensing, 165# 2400 Volt. Early release.

ITEM 952 — Built 1936
2000 KW. Moore non-condensing turbo. 185# ISP, 40# GBP, 3000 RPM.

BOILERS

ITEM 1671 — Built 1942
Three 210 HP 200# 100 SH. 3 drum, Erie City. Underfeed stoker.

ITEM 1777 — Built 1936
Two 210# 160#. 3 drum Vogt. Oil and gas fired.

ITEM 3 — Built 1927
750 HP 250#. Bent tube, **Union, with radiant front wall.** Wemco stoker.

ITEM 1118 — Built 1930
400 HP 375# 675#. Springfield Sect'l. header. Gas and oil fired. Ship in 10 days.

ITEM 1773 — Built 1946
C. E. Co. Stoker, two unit spreader type, cinder return etc. 8' 6" by 10' 4" L. Several modern underfeed stokers and pulverizers.

MGs—ROTARIES

ITEM 1783 — Rebuilt and guaranteed
300 KW Synchronous M. G. Set. 2400 Volt to 250 Volt D.C. 900 RPM Panel and starter.

ITEM 815 — **Two 1500 KW Synchronous Booster Rotaries.** 13.8 KV to 250 Volt D.C.

ITEM 816 — Built 1924
3000 KW Synchronous Booster Rotary. 13.8 KV to 250 Volt D.C. Modern transformers.

MODERN DIESELS

ITEM 1766 — **Three 60 KW General Motors.** 60/3/220 Volt. Totally enclosed.
ITEM 316 — **1000 KW General Motors.** 60/3/2400 Volt. Rebuilt guaranteed.

TRANSFORMERS

ITEM 1521 — Built 1939
27000 Total KVA Wemco Furnace Transformers 13.2 KV to 160/240V.

ITEM 1638 — **STEAM PLANT—Complete—2400 Volts. Condensing**
A: 1500 KW Wemco 250#. B: 500 KW G.E. 175#. C: 410 HP 260# 550° Murray. D: 400 HP 275# 550° Murray. (C & D with stokers.) E: 300 HP 175# 480° Heine. Complete with all accessories

ITEM 600 — **SURFACE CONDENSER—Relined—Rebuilt**
Worthington—about 70,000 #/hr. Pumps and ejectors 1941.

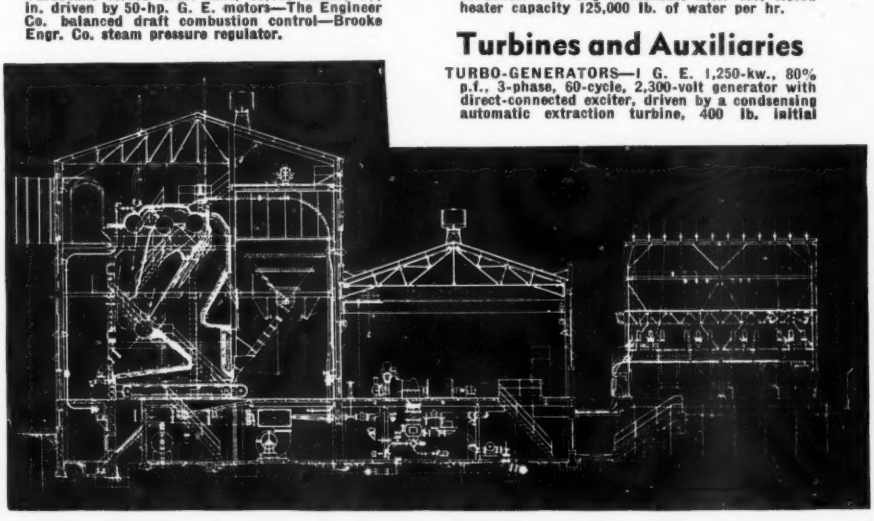
PAUL STEWART
UNION TRUST BUILDING • CINCINNATI, 2 OHIO
MAin 5873
MAin 3427

ENTIRE POWER PLANT AND INDUSTRIAL SITE

Suitable for manufacturer interested in generating own power and steam. In excellent condition, ready for operation. Community desirous of having new manufacturing concern in this locality. Excellent labor market. . . . . Or will consider dismantling and sale of equipment. Attractive offer for interested party.

BOILERS—2 Combustion Eng. Co. 4-drum bent-tube, 7,026 sq. ft. 450 lb. 125 deg. superheat; 60,000 lb. per hr. Water walls, front plain type, 195 sq. ft.—Elesco Superheaters—Crosby safety valves—Elliott Co. stop and check valves—blow-off valves—Reliance water columns—Bayer Co. soot blowers—Schutte & Koerting electric water column—Swartwout Co. 400-lb. reducing valves—Elliott Co. desuperheaters Bailey desuperheater control.
STOKERS—2 Coxe Traveling Grate, 211 sq. ft. Reeves 5-hp. drive 5:1 ratio—Sturtevant No. 80 Turbovane forced draft fans, 35,000 c.f.m., 5¾ in. driven by 50-hp. G. E. motors—The Engineer Co. balanced draft combustion control—Brooke Engr. Co. steam pressure regulator.

SETTINGS AND FURNACES—Boiler steel and casing plants—Boiler breeching—LaClede Christy suspended arches and sectionally supported front walls.
COAL AND ASH HANDLING EQUIPMENT—Coal bunkers, spouts and extension hoppers.
FEEDWATER APPARATUS—2 Worthington, 3-in., 5-stage, 225 g.p.m., 600-lb. pressure, centrifugal pumps, one driven by a 125-hp. G. E. motor and the other by G. E. turbine—Copes feedwater regulators—Cochrane continuous blowdown system, dearating heater, closed heater and vent condenser and oily condensate filter set; closed heater capacity 125,000 lb. of water per hr.



Turbines and Auxiliaries

TURBO-GENERATORS—1 G. E. 1,250-kw., 80% p.f., 3-phase, 60-cycle, 2,300-volt generator with direct-connected exciter, driven by a condsensing automatic extraction turbine, 400 lb. initial press., 125 deg. superheat, 160 lb. extraction; 1 G. E. 1,000-kw. generator similar to above, driven by a condensing automatic extraction turbine, 160 lb. initial press., 5 lb. extraction; G. E. generator air coolers—Ingersoll-Rand surface condensers, Circulating, condensate and air pumps—Schutte & Koerting turbine throttle valves, oil cooler and oil-operated extraction non-return valves—Atwood & Morrill Co. atmospheric and extraction pressure relief valves.
SWITCHBOARD—5-cubicle G. E. board, 2,300 and 11,000 volts, complete with load limit relays.
TRANSFORMERS — 3 G. E., 500-kv-a., 2,300/11,000-volt step-up transformers; 3 Maloney 100-kv-a., 2,300/440-volt transformers—Distributing tower by Railway & Industrial Engr. Co.
FLOW METERS—2 Brown boiler steam flow, 3 distribution meters.
GAGES AND THERMOMETERS—2 Brown Instr. Co. flue gas temp., 2 boiler steam temp., 1 feedwater temp., and 1 reduced pressure steam temp., recording thermometers; 1 boiler steam press., and 1 two-pen recording pressure gages—Two Bailey Meter Co. multi-pointer draft gages—Misc. indicating pressure gages.
2 Hays Corp. CO_2 Recorders.

Miscellaneous Equipment

Chapman Valve Co. and Pratt & Cady valves—Strong, Carlisle & Hammond traps—M. W. Kellogg Co. piping—Spray Engr. Co. spray pond equipment—Belfield Valve Co. spray pond level control valve—Herman Nelson Co. Unit heaters—Cochrane Corp. oilseparators and drainers—Schade Valve Co. pump governors—Shaw Box Co., overhead crane.

THOSE INTERESTED CAN INSPECT PLANT JEDDO HIGHLAND COAL CO. LOCATED (7) MILES NORTH OF HAZLETON, PA.
Call at Company's office — Jeddo, Pa. —for information.

For Plans or Data communicate with

H. M. WILSON CO.
Engineers
18th and Brandywine Sts., Phila. 30, Pa.
***Tele.:* LOcust 7-0200**

COMPLETE POWER PLANT

Available in approximately 90 days

EQUIPMENT MAY BE INSPECTED IN OPERATION

ONE 40,000# PER HOUR steam generating plant, 230 volts D.C. with 200 KW SKINNER UNIVERSAL UNIFLOW ENGINE GENERATOR SET and 200 KW AMES VERTICAL ENGINE GENERATOR SET, boilers, coal bunkers, synchronized combustion controls, all piping and valves, firing equipment, pumps, and 200 ton engine driven VILTER AMMONIA COMPRESSOR. The above equipment is in first-class condition and is subject to prior sale.

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FLETCHER SALES CO.

325 Fincastle Building LOUISVILLE, KY.

TURBO GENERATORS

1—500 K.W., 3 phase, 60 cycle, General Electric non-condensing.
500 KW., 3 phase, 60 cycle, 440 volt Gen. Elec. #39937 with surface condenser, evactor, and switchboard.
750 KW. Gen. Elec., 150 lbs. steam, 10-20 lbs. extraction.

MOTOR GENERATORS

100 KW., 125 volt Gen. Elec. to a 150 HP., 3 phase motor.
80 KW., 80 volt Burke with synch. motor and panels.
50 KW., 250 volt Westgh. to 3 phase synch. motor.

TRANSFORMERS

2—500 KVA, Pittsburgh, 33000 x 13200/6600.
3—400 KVA, General Electric, 13200 x 120/240.
2—150 KVA, Pittsburg 2300 x 230/460 volt.
2—150 KVA, Pittsburgh 2400 x 120/240 volt.
Over 100 NEW Gen. Elec. up to 75 KVA, 450 x 120 volt.

DC ENGINE GENERATOR

150 KW., 125 volt Crocker Wheeler to a 4 cylinder vertical Ames engine.

MOTORS

Large stock AC & DC motors.

CAPACITORS

50—15 KVA, 220 volt, 3 phase, new, General Electric.

A. C. GENERATORS TO GASOLINE ENGINES

3—25 KVA, 120 volt, 1 phase, 60 cycle, 900 rpm, Westinghouse, with exciters to LeRoi Gasoline engines with panels, etc.
All above equipment actually in stock. Send for our list of many other items we have.

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Power Plant Equipment Company
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AVAILABLE FOR IMMEDIATE DELIVERY PERFECT CONDITION

1—750 KVA UNAFLOW ENGINE GENERATOR SET, right hand, consisting of:

1—G. E. 750 KVA Generator ATB—150 RPM—Form E, 600 KW, 3 phase, 60 cycles, 2300 volts, .8 PF.
1—Filer & Stowell 26 x 36 Non condensing Unaflow Engine, 175# steam pressure, 10# back pressure.
1—G. E. Belted 20 KW-125V, 725 RPM Exciter.
1—Switchboard for generator control.
STILL SET UP AS OPERATED.

Also—large assortment Motors—(chiefly GE Triclad), 3 phase, 60 cycle, 220-440V, including unused 3-60 HP 3500 RPM.

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NEW-USED
RECONDITIONED
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1 KVA up to 200 KVA in stock

ARROW TRANSFORMER CO., INC.
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ASME BOILERS Nat'l Bd.

2—104 HP sectional steel header cross drum Springfield, 10' settings, oil fired.
2—25,000# (normal rating) Stirling's pulverizers, 425#.
2—400 HP sectional header, underfeed stokers.
1—300 12' settings, 7 years old, stack & breeching for these 3 units.

H. P. BREARLEY
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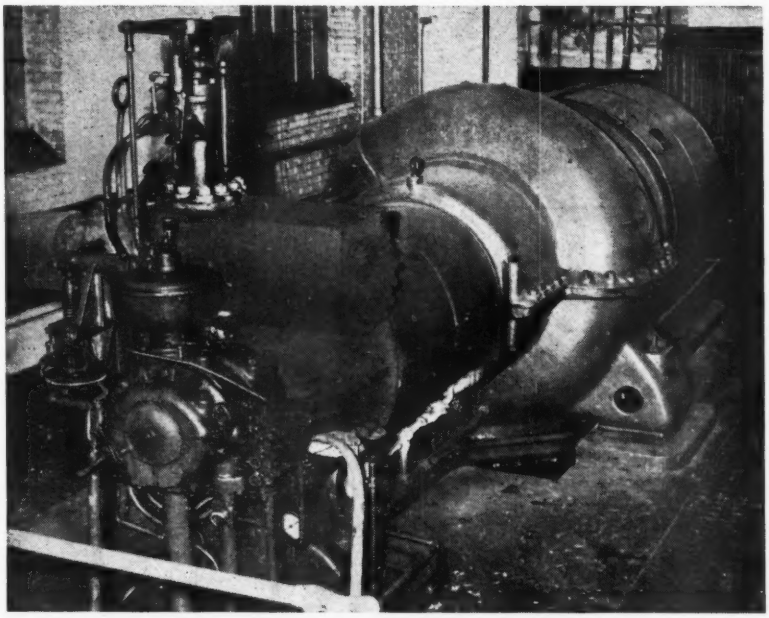
STRICTLY UTILITY, EFFICIENT CONDENSING STEAM TURBO-GENERATOR UNIT



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General Electric, 3600 RPM condensing steam turbo generator unit consisting of:

TURBINE

1500 KW, 17-stage, 225-250 P.S.I., 100° F.S. direct connected to:

ALTERNATING CURRENT GENERATOR

1500 KW, 80% P.F.—1875 KVA, Type ATB-2, Form HT, 3 phase, 60 cycle, 471 Amp., 2300 volts, complete and equipped with

ACCESSORIES

3500 sq. ft. C.H. Wheeler surface condenser, condensing auxiliaries, piping, valves, duplicating exciter sets, switchboard and instruments.

EXCELLENT CONDITION

UTILITIES ELECTRICAL MACHINERY CORPORATION

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DIESEL-GENERATORS

5 KW. TO 1000 KW.

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45 Years of Service

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CROCKER WHEELER MOTOR

300 HP, 230 Volts D.C., 500 RPM, Type CCM, Size 108DA, complete with Starting Control Panel.

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SOCKET TYPE METER

Types G.E. 1-14 and 1-16 Converted from house type

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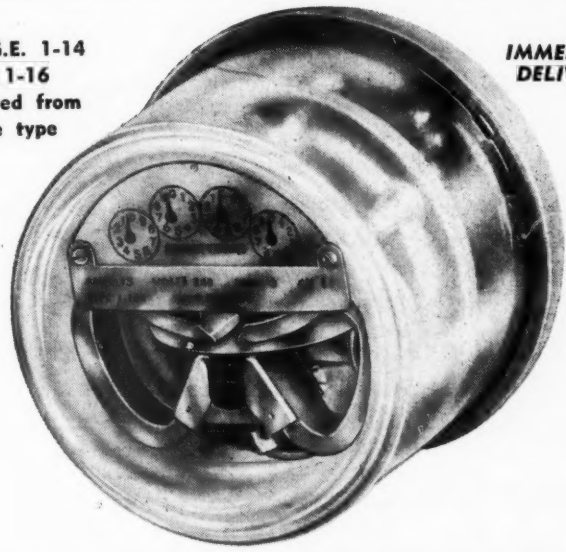

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TEL.- MAIN 4-6868

SPECIAL:

New Package Steam Generators—Fully automatic.
Designed to use light or heavy oil or gas.
Complete with all auxiliaries—Ready to install.
Sizes 30 to 250 H.P.—Steam Working Pressures—15#—100#—125#—150#—Delivery early 1949.

4—400 H.P. Water tube Boilers—225# S.W.P. Immediate delivery.

1—2500 K.W. Westinghouse Turbo Generator Set—Condensing—3 Phase, 60 cycles, 2400 volts. Immediate delivery.

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125, 150, 250, 300, 350 HP Motors—Rebuilt
75 Ton 65' span O.E.T. Crane—Motors
120-187-312 KVA Gens. dir. con. Engines
2—109 & 150 HP Kewanee Boilers—95% New
150 HP Cade HRT & 35 HP Scotch Marine
1250 KW Non-condensing Turbo Gen. Set

H. & P. MACHINERY CO.
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SPECIAL OFFERING

500 KW West. Syn. M. G. Set 250 v.—2200/4000/3/60 factory built with panels.
450 KW G.E. Syn. M. G. Set 125 or 250 v.—2200/3/60 factory built with panels.
Air Comp. 1100 cu. ft. 100# Chg. Pn. direct con. 215 HP Syn. Motor 2200/3/60.
Air Comp. 750 cu. ft. 100# Chg. Pn. Belted 150 HP AC or DC Motor.
3—300 HP Slip ring Motors 2200/3/60 600 RPM.
1—300 HP Slip ring Motor 2200/3/60 450 RPM.
1—300 KW West. 250 v. 1200 RPM DC Generator.
1—150 KW West. 125 v. 1200 RPM DC Generator.
1—375 HP West. DC Motor 230 v. 430/860 RPM.
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150 and 200 HP West. SK 230 v. 400/800 RPM.
50—75—100—200 & 300 HP Electric Ho'sts.

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Two 80 HP. Erie Economic 125 lb.
One 75 HP. Leffel Scotch 125 lb.
Two 100 HP. Hamburg V.T. 125 lb.
Two 80 HP. Hamburg V.T. 125 lb.

above Boilers in use 2 yrs.

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DIESEL ENGINES — DIESEL GENERATORS
TURBO GENERATORS

WE HAVE ON HAND ONE OF THE LARGEST INVENTORIES OF POWER EQUIPMENT IN THE EAST . . . . . .

MOTOR GENERATORS - STEAM ENG. GENERATORS - CENTRIFUGAL FANS - CENTRIFUGAL PUMPS
ROTARY PUMPS - RECIPROCATING PUMPS - MACHINE TOOLS - MOTORS A-C D-C - AIR COMPRESSORS

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TURBO-GENERATORS
1—8000 KVA Westinghouse 2400 V surf. cond.
1—3750 KVA G.E. 480 V. cond.
1—2500 KVA Allis-Chalmers 2300 V cond.
1—1250 KVA G.E. 480 V mixed pressure

ENGINE GENERATORS
2—675 KVA Skinner Unaflow—direct connected to Westinghouse 240/480 V gen.
1—675 KVA Allis-Chalmers full releasing Corliss 480 V
1—375 KVA Ames vertical 220/440 V
1—275 KVA Ridgeway N.R.C. 2300 V
1—187 KVA Ames vertical
1—156 KVA Ames vertical 240 V

DIESEL ENGINES
General Motors, Fairbanks, Fulton, Nordberg and Buda from 15 to 1000 KW New and Rebuilt

ELECTRICAL EQUIPMENT
Large stock of Transformers, Motors, M.G. Sets, and Generators

WIRE—PHONE—WRITE
For Complete Specifications

LARGEST STOCK OF MODERN POWER PLANT EQUIPMENT ON THE PACIFIC COAST

BEESON ENGINEERING CO.
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Mutual 9151

FOR SALE

4000 KW TURBINE GENERATING PLANT

Consisting of

1—2000 KW and 2—1000 KW General Electric, 3 phase, 60 cycle, 480 Volts, 3600 R.P.M. Condensing Turbo Generator Units. Complete with all Auxiliaries. General Electric inspection reports are available.

A. G. SCHOONMAKER CO., INC.
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1350 HP FAIRBANKS MORSE DIESEL PLANT

Consisting of 1-150, 1-300, 2-450 HP Model 32E late model units. Direct connected 2300 volt generators. Complete plant with all operating auxiliaries.

Immediate delivery.

Complete details on request.

MISSISSIPPI VALLEY EQUIPMENT CO.
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5 KW. TO 1000 KW.
NEW-USED
RECONDITIONED

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MOTOR GENERATOR SETS
ALTERNATORS, ALL FREQUENCIES
TRANSFORMERS, LARGE STOCK
D. C. GENERATORS, ALL VOLTAGES
CONTROL EQUIPMENT

ALL SIZES
VOLTAGE AND CYCLES

3 ph. 60 cy. A.C. Motors
3 ph. 25 cy. Motors
125 Volts D. C. Motors
230 Volts D. C. Motors
550 Volts D. C. Motors

THE FRED W. KIEMLE CO., 33 N. SUPERIOR ST., TOLEDO 4, OHIO

Put all idle equipment to work. Send your list for prompt action. WRITE OR WIRE YOUR INQUIRIES

850 C.F.M. DUPLEX AIR COMPRESSOR

12"x14", 100 P.S.I., Center Drive Flywheel, Lubricator, Unloaders

1—2000 GPM 150 PSI 8" Centrifugal Pump with direct coupled 240 HP Steam Turbine on base.
1—6000 GPM 16" Centrif. Pump.
3—750 and 1000 GPM Knowles Reciprocating Steam Pumps.
1—14" Roots Vac. or Press. Blower.
21—Air Compressors, various cap.
2—375 CFM Worthington 12" x 9" horizontal Vacuum Pumps.
5—2000-5000 GPM 32'-65' hd. 10" & 12" Cent. Pumps.
11—Nash Vac. & Cond. Return Units.
300—Rebuilt Elec. Motors 1-200 H.P.
4—Kinney unused, 6" Rotary Pumps.
90—Exhaust & Turbo Blowers.
17—Triplex Pumps, various sizes.
9—Nash 1/20, 0, 1, 2 wet vac. pumps.
3—Blackmer Rot. 6" pumps 500 gpm.
1—Norwalk 4-stage Compressor 28 CFM, 5000 PSI, 20 H.P. Motor.
1—GE Turbo Blower 2-st. 3000 cfm, 16 psi. Also 1-st. 3000 cfm, 8 psi.
1—#70 Buffalo paddle wheel Blower.
1—Hydr. Triplex Pump 2-st. 3000#.
3—1000 GPM 280' hd. 6" bronze Cent. Pumps direct connected to 100 H.P. Buda Diesel Engines.

SUPERIOR EQUIPMENT CO.

136 GRAND ST., N. Y. C., CAnal 6-6983-4

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COMPLETE 2500 KW STEAM POWER PLANT

consisting of two, 1250 KW 3-phase 60-cycle, 2300-volt, Allis-Chalmers turbo-generators with control panels, condenser, boilers, economizers, super-heaters, feed water regulators, pumps, piping, induced-draft fan, direct firing coal pulverizers with bin and stand-by fuel oil burning equipment. All equipment complete with motors and controls where required. In excellent condition and now available.

CONSOLIDATED CEMENT CORP.

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FOR SALE

2—150 KVA. 60 CY. 1 PH. 2400-240/480 SCOTT TAPS.
6—100 KVA. 60 CY. 1 PH. 2400-240/120.
6— 75 KVA. 60 CY. 1 PH. 2400-240/120.
9— 50 KVA. 60 CY. 1 PH. 2400-240/120.
7—37½ KVA. 60 CY. 1 PH. 2400-240/120.
8— 15 KVA. 60 CY. 1 PH. 2400-480/240.

ALSO ALL TYPES OF AIR COOLED AND PHASE CHANGERS.

ATLANTIC TRANSFORMER CO.

5143 N. 2nd St. Philadelphia 20, Pa.

TURBO-GENERATORS

200 KW. TO 5000 KW.
NEW-USED
RECONDITIONED

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DIESEL ELECTRIC GENERATORS

IMMEDIATE DELIVERY

200 KW GENERAL MOTORS DIESEL ENGINE Model 8-268A—8 Cylinder—400 H.P. 1200 RPM—Direct connected to:-200 KW A.C. Generator—3 Phase 60 Cycle—440 Volts—.8 P. F.

100 KW GENERAL MOTORS DIESEL ENGINE Model 3-268A—3 Cylinder—150 H.P. 1200 RPM—Direct connected to:-100 KW A.C. Generator—3 Phase 60 Cycle—440 Volts—.8 P. F.

COMPLETE WITH PANEL BOARD AND STARTING EQUIPMENT
RECONDITIONED & GUARANTEED EQUAL TO NEW
ONLY TWO OF EACH SIZE AVAILABLE

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SURPLUS ELECTRICAL EQUIPMENT

2—2100 HP, GE Synchronous motors, 514 RPM, 4600/2300 V, 3 phase, 60 cycle, 80% P.F. Complete with rheostats and belted exciters. Full details on application.
2—2000 KVA Transformers—Single phase 60 cycle, 69/34.5 KV to 4800/2400 V. Westinghouse O.I.S.C.
1—3500 KVA—3 phase, 60 cycle, 33/13.8 KV Westinghouse Transformer.
1—600 A., 3 P.S.T., 34.5 KV Outdoor O.C.B. Westinghouse CO-1-A.
1—3 pole, 600 A, 34.5 KV Outdoor Disconnect Switch.
Miscellaneous Distribution Transformers, Cable, Switches, Potheads and Electrical Instruments. Also Ross Carrier—hardly used. Arch measurements—91" high and 76" wide. 7 Ton capacity.

All the above are for immediate sale and are located at our Pulp Mill on Vancouver Island.

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IMMEDIATE DELIVERY

HARD-TO-GET ELECTRICAL EQUIPMENT – NEW!

NEW SLIP RING MOTORS

All 220/440 Volt

Qu.	HP	Speed	Mfg.
1	100	900	Elliott
1	100	720	Elliott
3	125	720	Elliott
2	150	720	Elliott
*1	250	900	G.E.
2	500	1200	Elliott

*Used—Reconditioned

New C-H semi-magnetic controls for above in stock.

NEW MAGNETIC SLIP RING CONTROLS

16—250 HP, 440 volt (125 HP, 220 volt) Allis reversing and plugging with air ckt. breaker, speed regulating or auto. acceleration.

NEW GEARHEAD MOTORS

All 220/440 Volt

Qu.	HP	Output	Frame	Mfg.
1	1	125	204	Stlg.
1	1	350	204	Stlg.
1	2	45	225	Stlg.
2	2	125	254	U.S.
1	2	230	224	Stlg.
7	3	45	254	Whse.
4	3	350	225	Whse.
8	5	41	254	Whse.
4	7½	25	324	U.S.
1	10	20/60	324	Stlg.

NEW M-G SETS

25—Reliance 7½ VS (6KW) 380/440—50/60 with var. voltage D.C. (275 max.) belt driven exciter.

NEW D. C. CONTROLS

50—5 to 150 HP, 230 D.C. with and without FA relays.

NEW D. C. MOTORS

All 230 Volt

Qu.	HP	RPM	Frame	Mfg.
5	5	1750	23 T	Rel.
5	10	1750	34 T	Rel.
8	10	515/1750	78 T	Rel.
5	35	850	230 T	Rel.

Reconditioned - Guaranteed

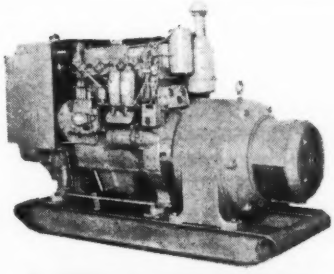
3	15	400/1600	131 T	Rel.
1	20	500/1500	123 SK	Whse.
1	25	300/1200	153 SK	Whse.
2	40	500/1500	SK	Whse.
2	75	500/1500		C W
2	100	500/1500	183 SK	Whse.
1	125	600/1800	1050 T	Rel.
1	250	275/690		G.E.

NEW REDUCERS

5—Falk 5 HP, 28DU, 10:1
5—Falk 10 HP, 32DU, 10:1
1—Abart 12 HP, 6 A, 18.5:1
2—Foote 15 HP, 60DX, 10:1

The Boswick Electric Co.

P. O. Box 55, Akron 9, Ohio — *Telephone Walbridge 1195*



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DC and AC; 50 and 60 Cycles

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Also Marine Engines
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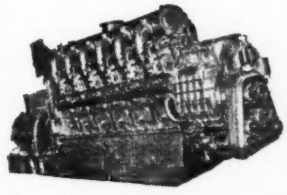

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1000 KW, 2400 Volts, 3 Phase, 60 Cycle, 720 RPM, General Motors Model 16-278A.
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600 KW, 2400 Volts, 3 Phase, 50 Cycle, 600 RPM, General Motors Model 12-567.
300 KW, 450/2400 Volts, 3 Phase, 60 Cycle, 1200 RPM, General Motors Model 8-268A.
200 KW, 450/2400 Volts, 3 Phase, 60 Cycle, 1200 RPM, General Motors Model 8-268A.
50 KW, 440 Volts, 3 Phase, 60 Cycle, 900 RPM, Fairbanks-Morse Model 36A 5½.
100 KW, 3 Wire, 125/250 Volts DC, 1200 RPM, General Motors Model 3-268A.
900 HP, General Motors Model 12-567, Propulsion Unit Complete.

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FOR SALE

One—80 H. P., D. C., 230 volts, 450 RPM, Compound Interpole, Crocker Wheeler, Size 101-H, Type CCM, Ser. #485267, with Slide Base and Control.

In excellent condition. Full commutator.

C. V. HUNT, INC.
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FOR SALE

New Chrysler Diesel Power Units, 75 HP, Model IND-3, 6 Cyl., Elec. Start, Includes: 4 batteries, Radiator, Spare Parts and Twin Disc Clutch.

2—50 and 75 KW Caterpillar Diesel Generating sets, 3/60/120/208 V., mounted on steel base including radiator. Rebuilt.

New 30 KW 6 cyl. Diesel Generator sets, 3/50/220/380 Volts. Complete. Immediate shipment.

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NEW-USED
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Rebuilt and Sold with a Standard New Guarantee

IND. FREQUENCY CHANGERS SETS
ALL SIZES, VOLTAGE AND CYCLES

MOTOR GENERATOR SETS
ALTERNATORS ALL FREQUENCIES
TRANSFORMERS LARGE STOCK
D. C. GENERATORS ALL VOLTAGES
CONTROL EQUIPMENT

3 ph. 60 cy. A. C. Motors
3 ph. 25 cy. Motors
125 Volts D. C. Motors
230 Volt D. C. Motors
550 Volt D. C. Motors

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BERGER BROTHERS Electric Motors, Inc., 395 STATE ST., ROCHESTER 4, NEW YORK
PUT ALL IDLE EQUIPMENT TO WORK. SEND YOUR LIST FOR PROMPT ACTION.

We Are Offering for Immediate Delivery

PUMPS FOR SALE

2—De Laval 2 Stage, 600 G.P.M., Turbine Drive, 364 Foot Head, 140 Lbs. Steam Pressure, 1750 R.P.M., With Fisher Control.

2—Electric, 600 G.P.M., 364 Foot Head, 1750 R.P.M.

2—Electric 75 H.P. Motors, 280 Volts, 3 Phase, 6 Cycles.

2—De Laval Pumps, 2 Stage, 675 G.P.M., Turbine Drive, 462 Foot Head, 140 Lbs. Steam Pressure, 1750 R.P.M., Fisher Control.

1—Boiler Feed Pump — Byron Jackson make, 3x9 7 Stage, Terry type Turbine, 50 H.P., 150 Lbs. Pressure.

1—Byron Jackson 3x9 Type H.S., 200 G.P.M., 150 Lbs. Pressure, 1750 R.P.M., With 50 H.P., 280 Volts, 3 Phase, 60 Cycle Motor.

ENGINES & GENERATORS FOR SALE

GENERATOR—K.W. 400, Volts 125, Amps. 3200, Westinghouse Electric & Mfg. Co.
ENGINE—Allis Chalmers Co.
GENERATOR—Amp. 4800, Speed 150, Volts 125, General Electric Co.
ENGINE—Skinner Engine Co., Erie, Pa. Universal Unaflow.
GENERATOR—K.W. 200, Volts 125, Amps. 1600, R.P.M. 100, Westinghouse Electric Mfg. Co.
ENGINE—Allis Chalmers Co., Milwaukee.
GENERATOR—K.W. 300, Volts 125, Amps. 2400, R.P.M. 100, Westinghouse Electric & Mfg. Co.
ENGINE—Allis Chalmers Co., Milwaukee.

MOTORS

(3) 40 HP— 900 R.P.M.—125 V, D.C.
(1) 40 HP—1800 R.P.M.—125 V, D.C.
(1) 30 HP— 900 R.P.M.—125 V, D.C.
(3) 20 HP— 900 R.P.M.—125 V, D.C.
(3) 10 HP— 900 R.P.M.—125 V, D.C.

Complete with cast iron motor base and pushbutton magnetic starters.

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TURBO-GENERATORS

200 KW. TO 5000 KW.
NEW-USED
RECONDITIONED
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SCOTCH BOILER

57 HP, 125# Leffel, Kisco System, Ray Oil Burners and Stack. Excellent condition.

F. W. HAY & COMPANY
2734 Cherry Street
Kansas City, 8, Missouri

100 H.P. AMES ECONOMIC
ASME 125 LB. PRES. BOILER
60 FT. STACK & GRATES

DARIEN CORP.
60 E. 42nd St. N. Y. 17, N. Y.

CENTRIFUGAL PUMPS

Rebuilt and Guaranteed

2—Warren 20"x16", Size 20, Type 16DL 8500 GPM, 45' Head, complete with 125 HP 440/3/60 870 RPM Motors.
1—Dayton-Dowd Type CSLH 10"x10", 2000 GPM, 118' Head, complete with 75 HP 440/3/60 1800 RPM motor.
1—Dayton-Dowd, Type CSLH 10"x12", 3000 GPM, 130' Head, complete with 125 HP 440/3/60 1800 RPM motor.
2—Dayton-Dowd, Type CSLH 12"x14", 5000 GPM, 130' Head, complete with 200 HP 440/3/60 1800 RPM motor.
3—Goulds All Bronze 4"x3" 2-stage 400 GPM 150' Head 1750 RPM, 25 HP 1750 RPM motor.
1—Allis-Chalmers Type S all Bronze 6"x5" 1000 GPM, 230' Head, 100 HP 1750 RPM motor.

C & S MACHINERY CO.
715 Howard St. St. Louis 6, Mo.

ALL TYPES OF
POWER PLANT EQUIPMENT
AVAILABLE

We Are Specialists in Power Plant Engineering and Installation Work

WARNER J. SHERB
INC.
342 Madison Ave., N. Y. 17, N. Y.
Murray Hill 2-9098

TRANSFORMERS

3—100 KVA Westinghouse Transformers. 13800 Primary voltage, 230-460 secondary voltage, 60 cycle, oil bath type, with percentage taps. Excellent condition. Available for immediate delivery.

THOMPSON CRUSHED ROCK CO.
R. R. #2 Kansas City, Kansas
Telephone ATwater 0335

Wing Steam Turbines

(2) Almost new—Sizes 4 DRG, serial No. 22386 and 5 DRG serial No. 72811. Bargain. Call Schornstein, New York Phone: Stillwell 6-2600.

ADOLF J. MAINZER, INC.
37th Ave. & East River, Long Island City 1, N.Y.

SLIP RING MOTORS
3-Ph., 60 Cy.

HP	Volts	Make	Speed
450	440/220	Whse.	514
300	440/220	G.E. MTC	600
200	2200/440	G.E.	1200
200	440	G.E.	450
150	440/220	Whse. (2)	1800
150	2200/440	G.E.	1200
125	440/220	G.E.	600
125	440/220	G.E. (Hoist)	900
100	2200/550	G.E.	1800
100	440/220	G.E.	1200
100	2200/550	G.E.	1800
80	440/220	G.E. (MTC)	900
75	2200/550	G.E.	1800
75	440/220	Whse. 25 cy.	750
50	440/220	G.E.	900

SYNCHRONOUS MOTORS
3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	2200/440	G.E.	ATI	600
250	440/220	Whse.	HR	277
200	4150/2300	Whse.	G	1800
150	4150/2300	G	G	1800
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	G.E.	TS	900
100	440/220/25 cy	G.E.	TS	375
100	440/220	Whse.	G	1800
75	440/220 (new)	Whse.	G	1800
75	2200/440	Whse.	GE	600

TURBO-GENERATOR

Generator, 62½ kva, 1200 rpm, 440/220 volt, Whse, direct connected through reduction gear to Turbine, 50 kw, 7300 rpm, non-condensing, 125/150 lbs. ga., pr.

AIR COMPRESSOR UNIT

1—13" and 8" by 10" Worthington FEATHER-VALVE, 285 rpm. 110 lbs. ga. motor-driven.

CIRCUIT BREAKERS

1—5000 amp., ITE, 3 pole, 600 v., air
2—2000 amp., GG E, 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air
2—1200 ampere, Whse, 3 pole, 600 v., air

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
700	2300	Whse.	CS	1800
600	2300/440	G.E.	KT	1200
500	440/220	G.E.	IK	900
400	550	G.E.	IK	720
350	2200/440	Whse.	CS	600
300	2200/440	Whse.	CS	600
200	440/220	G.E.	TEFC	1800
200	2200/440	G.E.	KF	720
200	2200/550	Cr. Wh.	SC	900
200	2200/440	G.E.	KT	1200
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1800
150 vert.	440/220	G.E.	KTP	1200
125 vert.	440/220	G.E.	KTP	1200
100	550	Cr. Wh.	Q	900
100	440/220	G.E.	KT	450
100	2200/440	G.E.	K	1200
100	2200/550	G.E.	KT	900
75	440	G.E.	KT	400
60	440/220 (new)	L. Allis	OGA	1800

A. C. GENERATORS

1—230 kva., 600 rpm., 440/220 v., G.E.
1—300 kva., 600 rpm., 2200/440 v., G.E.
1—225 kva., 600 rpm., 220/440 v., G.E.
1—150 kva., 1800 rpm., 2200/550 v., Whse.
1—112 kva., 900 rpm., 440/220 v., G.E.
1— 98 kva., 1800 rpm., 440/220 v., G.E.
2— 75 kva., 1800 rpm., 440/220 v., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
200	230	Cr. Wh.	CMC	690
150	230 (new)	Cr. Wh.	TEFC	900
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
75	230 (new)	Whse.	SK	1150
75	230	Whse.	SK	850
75	230	Whse.	SK	1750

MOTOR GENERATOR SETS

1—150 kw., 250 v., 1200 rpm., conn. to 250 hp., 440/220 v., 3 ph., sq. cage Whse. motor.
1—100 kw., 250 v., 900 rpm., Cr. Wh., conn. to 150 hp., 440/220 v., sq. cage.
1—75 kw., 125 v., 1200 rpm., G.E., conn. to 120 hp. 2200/440 v., syn. motor.
1—75 kw., 250 v., 1200 rpm., Whse., conn. to 112 hp., 440/220 v., sq. cage motor.
1—50 kw., 250 1200 rpm., G.E., conn. to 75 hp., 440/220 440/220 v., 60 cy., G.E. syn. motor.
1—50 kw., 250/1200 rpm., G.E., conn. to 75 hp., 440/220 v., 60 cy., syn. motor.

TRANSFORMERS
60 Cy.

3—2000 kva., G.E., 25000-2300 volts.
3—1000 kva., G.E., 4160/7200-230/460 volts.
1—1000 kva., Al. Chal. 2400-120/240/208 volts, 3 ph.
3— 500 kva., G.E., 11000-460 volts.
1— 400 kva., G.E., 2300-230/115 v.
3— 250 kva., G.E., 6900/11950Y-600 volts.
3— 200 kva., G.E., 4800/2400-120/240 v., 1 ph.
1— 150 kva., Whse., SK, 13200-125/215 v., 3 ph.
6— 100 kva., G.E., 4600/2300-230/115. NEW.
3— 100 kva., G.E., 450-115/230 v., dry, 1 ph., new.

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

POWER PLANT EQUIPMENT
FOR SALE

1—2500 KW 3/60/2300 G. E. condensing turbo - generator 165 P.S.I. (can be changed to 400 P.S.I.). Complete auxiliaries.
1—1250 KW 3/60/2300 Allis-Chalmers condensing turbo-generator 165 P.S.I. Complete auxiliaries.
1—750 KW 3/60/2300 G. E. condensing turbo-generator 165 P.S.I. Complete auxiliaries.
4—Whitlock Type R fuel oil heaters 14,000 lbs./hr. with 185 lbs. steam.
2—New C. H. Wheeler, 720 sq. ft. shell and tube condensers 20" inlet.

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Tampa, Florida

DIESEL-GENERATORS

5 KW. TO 1000 KW.
NEW-USED
RECONDITIONED

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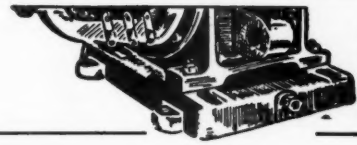
507 FIFTH AVE., NEW YORK 17, N. Y.
MURRAY HILL 7-6547

MOTORS • CONTROLS • GENERATORS

Rebuilt Guaranteed Equipment in Stock

SIZES FROM 1 HP TO 250 HP



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245 Centre St.
New York 13,
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Digby 9-1744

TRANSFORMERS

MOTORS—GENERATORS—MOTOR GENERATOR SETS

WORLD'S LARGEST INVENTORY

PARTIAL STOCK LIST AS OF DEC. 1, 1948
60 Cycle—Oil Type Transformers

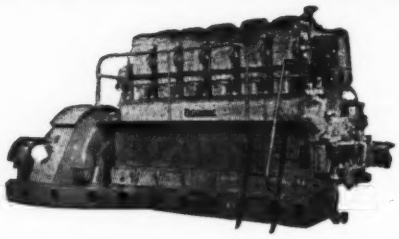
QUA.	KVA.	P.V.	S.V.	Phase	QUA.	KVA.	P.V.	S.V.	Phase
2)	3900	23000	2300	3	3)	333	13800	115/230	1
	1500	2300	600	3	3)	333	13800	2300	1
	1000	2300	230	3	3)	333	2300	115/230	1
3)	633	33000	2300	1	3)	250	2300	230/460	1
	750	2300	2300	2/3	3)	200	4600	115/230	1
3)	667	2300	600	1	3)	200	7200	230/460	1
3)	500	7200	230/460	1	3)	200	2300	230/460	1
3)	500	13800	230/460	1	3)	200	2300	115/230	1
3)	500	2300	230/460	1	3)	150	13800	115/230	1
3)	500	23000	440	1	3)	150	2300	230/460	1

872 Smaller Ratings—Also Large Stock 25 Cycles and new Air-Cooled Transformers
Send Us Your Inquiries For
Motors, Generators, Motor Generator Sets
Immediate Shipment from our Large Stock—All Ratings
$ $ Cash for your Surplus Transformers $ $

Electric Equipment Co., Rochester 1, N. Y.

NEW ENTERPRISE DIESELS

450 HP
450 RPM
Model DSG-6



375 KVA
300 KW
AC STD VOLTAGES

Qu.	HP	Model	RPM	KVA	KW	GEN.	Ph.	Cycle	Volts
2	1600	General Motors 16-278A	720	1250	1250	General Elec.	3	60	2300
2	1600	General Motors 16-278A	720	1250	1000	Elliott	3	60	2400/4160
*1	500	Fairbanks Morse Type Y	257	415	415	Fairbanks Morse	3	60	2400
**3	450	Enterprise DSG-6	450	....	250	Elliott	..	DC	120/240
1	300	Buckeye Model E	400	250	200	Elec. Mchnry.	3	60	240
1	225	Buckeye Model E	400	187	150	Ideal	3	60	240
**3	125	General Motors 6016-E	1200/1000	75/62.5	60/50	General Elec.	3	60/50	127/220-230/400
1	100	International UD-18	1200	62.5	50	Westinghouse	3	60	240
**2	52	International UD-14	1200/1000	37.5/32.5	30/25	Elec. Mchnry.	3	60/50	127/220-230/400
**8	36/30	International UD-9	1200/1000	23/18.75	18.75/15	Elec. Mchnry.	3	60/50	240/440-127-220

*One Plant Consisting of Three Units, i.e. 65, 150, and 200 KW.
**New units (all other units used).

Diesel Motors
WE HELP TO LIGHT AND POWER THE WORLD
PORT WASHINGTON, L. I., N. Y. CORPORATION TEL: PORT WASHINGTON 7-2000

TURBO-GENERATORS

200 KW. TO 5000 KW.
NEW-USED
RECONDITIONED
J. PARKER THOMPSON CO., INC.
507 FIFTH AVE., NEW YORK 17, N. Y.
MURRAY HILL 7-6547

IN STOCK

#14/2, twisted pair, Hard Drawn Copper, rubber insulated and weatherproof braid, outside distributing wire, New, Full coils @ $29.45 M ft. net

#16/2, twisted pair, same as above @ $23.25 M ft. net

All wire fully guaranteed.

WRITE TO
TELE-WIRE SUPPLY CO.,
136 MAIDEN LANE, NEW YORK, N. Y.

SAVE 60% of New Cost on G. M. Marine Diesel

Used only for Demonstration in Naval Trade School

Model 6-278A Marine Diesel Engine, 600 S.H.P., Serial #10350 manufactured by Cleveland Diesel Engine Division, General Motors, complete with D.C. electric generator set and spare parts.

This Diesel Engine used only for observation purposes on a test stand in U. S. Navy Diesel Training School at Cleveland, Ohio—never been in actual use on ship—good as new. Included with engine is a 300 KW General Electric D. C. generator set installed on sub base of engine—also eight boxes of new spare parts, one exhaust muffler.

Present replacement cost, including spare parts $51,000. Engine built in 1942. *Write for itemized list—attractively priced.*

PETRUS INDUSTRIAL MACHINERY SALES
1486 West 25th Street *Tel. Main 1203* Cleveland 13, Ohio

CONDENSERS

G. E. Pyranol For Power-Factor Correction

1 Mfd.	20 K.V.	$25.00 ea.
.1 Mfd.	25 K.V.	9.85 ea.
.001 Mfd.	50 K.V.	12.50 ea.

New in original containers

All Prices Indicated are FOB Our Warehouse, NYC. Shipments will be made via Railway Express unless sufficient postage is included or other instructions issued. We will refund excess postage in stamps.

POWERTRON
ELECTRICAL EQUIPMENT CO.
117 Lafayette St., New York 13, N.Y.
Phone: WOrth 4-8610

FOR QUICK SALE

2—General Electric induction voltage regulators with a G. E. control cabinet attached on each regulator.

These regulators are two years old. They have been in use two years and have been under cover all that time. They are as good as new.

Price F.O.B. Elk River, $2,100.00 each. Will give a crew to help load only

Data off name plate

2—Induction regulators No. 8046350 & 8046351—Type IRS Form V. Single Phase 60 Cycles—out door service. 48 K.VA. continuous—55 C Rise. Impulse level full wave 60 KV.

Primary Volts	Load Amperes	% Rise	% Lower
2400	400	5	5
2400	200	10	10

Approx.—Total weight, 2480 pounds.
No. 10—C oil—61 gallons.

ELK RIVER MUNICIPAL UTILITIES ELK RIVER, MINNESOTA

FOR SALE, *CHEAP*

Skinner Uniflow engine, direct connected to 160KW, 220 V, 3 Ph generator, with exciter.

Skinner Counterflow engine, direct connected to 125 KW, 220 V, 3 Ph generator, with exciter.

165 HP Stirling boiler, stack, fan and Firite spreader stoker.

304 HP Vogt (4 drum) boiler, stack, fan and Firite spreader stoker.

SPALDING LAUNDRY & DRY CLEANING CO.
835 S. 13th St. Louisville 10, Ky

New and Used Equipment Available for
POWER PLANTS, SUBSTATIONS, TRANSMISSION LINES AND CONSTRUCTION
Send for new list to
EBASCO SERVICES INCORPORATED
APPARATUS EXCHANGE 120 Wall St., New York 5, N. Y.

FOR SALE
MODERN 1000 KW Turbo-Generator
in Excellent Condition

Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker, and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum, Textile, Pulp and Paper, and Sugar Refining Industries.

NEWMAN & COMPANY, INC.
739 Drexel Building Philadelphia, Pa.

FOR SALE
400 HP HEINE BOILER 200#
75 HP LEFFEL 125#
All types of used, rebuilt, and new boilers.
NICK COLBERT
609 E. 23rd St. Indianapolis 5, Ind.
Phone WABASH 5683

FOR SALE

2—Used 300 H.P. Boilers complete with steel stack, breeching, stokers, feed water pump and heater. Immediate delivery F.O.B. cars on acceptable bid.

MIDWEST MFG. COMPANY
Galesburg, Illinois

Most all units still on foundation. Many may be seen operating

TURBO UNITS (NON-COND.)

625 KVA General Electric 2300/480 v.
625 KVA Al. Chal. 480/240 v.
375 KVA (2) General Electric 2300-480 v.
250 KVA GE 480/240 v., 400#
250 KVA General Electric 600 v.
125 KVA GE 240/480 v.—Moore 250#
115 KVA Wghse. 2400/480 v.—Sturtevant
62.5 KVA GE 240/480 v.—DeLaval
62.5 KVA GE 480/240 v.—Terry 310#

TURBO UNITS (COND.)

1875 KVA (2) General Electric 2300 v.
1250 KVA Wghse. 2300 v., 425#
1250 KVA General Electric 2300 v.
1250 KVA (2) Al. Chal. 4000/2300 v., 300#
750 KVA General Electric 240/480 v.

SURFACE CONDENSER

3500 sq. ft. Wheeler

DIESEL UNITS

375 KVA FM "32E-14": 480/240 v.
250 KVA Elliott 240/480 v.—Buckeye
125 KVA Elliott 240/480 v.—Buckeye
156 KVA Ideal 240/480 v.—Buckeye
112 KVA Fairbanks Morse 32D-14
109 KVA GE 240/480 v.—Superior
93.8 KVA EM 480/240 v.—Superior
37½ KVA (3) General Motors 220/440 v. (NEW)

BOILERS

605 HP Union 3 drum 200#
508 HP Combustion 200#
507 HP Combustion 400#
469 HP Sterling 425#
406 HP Union (Heine) 200#
312 HP Sterling 180#
288 HP Combustion HRT 150#
255 HP Sterling 3 drum 170#
250 HP Erie City (Heine) 180#
200 HP (2) Vogt 160#
200 HP Erie City 3 drum 160#
125 HP (2) Scotch Marine 100#
110 HP Erie City 3 drum 160#
102 HP Ames (Economic) 125#

STEAM ENGINE SETS, A. C.

1125 KVA GE 488/240 v.—Nordberg Unif.
400 KVA GE 2300/480 v.—Erie City poppet v.
312 KVA GE 2300/480 v.—Chuse 4 v.
187 KVA GE 480/240 v.—Chuse 4 v.
187 KVA Wghse. 240/480 v.—Ames Ver. Unif.
187 KVA GE 2300 v.—Chuse 4 v.
79 KVA Al. Chal. 480/240 v.—Ames Unif.

STEAM ENGINE SETS, D. C.

300 KW GE 250 v.—Skinner Uniflow
300 KW CW 125 v.—Skinner Uniflow
200 KW GE 125 v.—Skinner Uniflow
150 KW GE 125 v.—Skinner Uniflow
75 KW CW 250 v.—Ames Ver. Uniflow

TRANSFORMERS

Three 400 KVA Wghse. 2300-230/460 v.
Two 200 KVA Wghse. 2300-230/460 v.

POWER PLANT EQUIPMENT CO., INC. 39 Cortlandt St. New York, N. Y.

FOR SALE

1—10,000# new Shepard Form 23, Motor Driven Trolley Hoist PB control for 220 AC.

1—5 ton Alliance Gantry Charging Crane, 20' span for 220 volts DC.

1—10 ton Morgan OET Cab Controlled Crane, 50' span, 220 DC.

1—35 ton ditto, 70' span.

1—15 ton Ditto.

1—2000# Cap. Shepard New Form 8 Elec. Hoist for 110/1/60 AC.

1—30 ton Cap. Hand Powerhouse Crane, 40' span, very good condition.

1—880 KW Nordberg Westinghouse Diesel Generator Set for 2400/3/60 AC, comp. Very good condition.

1—850 KW Nordberg GE ditto.

1—400 KW Nordberg Fairbanks Morse Diesel Generator, ditto.

1—4" x 8" Sturtevant Mill Roll Jaw Crusher, complete with belt drive, but less motor. New.

HAWKINS & COMPANY
122 SO. MICHIGAN AVE.
CHICAGO 3, ILLINOIS

HEADQUARTERS for GEARMOTORS

Brand New G.E. and U.S. 3 Phase 60 Cycle 220/440 Gearmotors in Stock

Guaranteed for One Year

8—	½ HP	84 rpm	9—	3 HP	45 rpm
13—	½ HP	190 rpm	3—	3 HP	190 rpm
3—	¾ HP	20 rpm	3—	3 HP	350 rpm
10—	¾ HP	190 rpm	2—	5 HP	155 rpm
5—	1 HP	37 rpm	8—	5 HP	230 rpm
7—	1 HP	100 rpm	6—	7½ HP	13.5 rpm
3—	1 HP	190 rpm	6—	7½ HP	420 rpm
10—	1 HP	280 rpm	1—	10 HP	100 rpm
2—	2 HP	16.5 rpm	3—	10 HP	125 rpm
4—	2 HP	37 rpm	3—	15 HP	350 rpm
10—	2 HP	190 rpm	1—	20 HP	100 rpm
2—	2 HP	230 rpm	1—	60 HP	56 rpm

ABOVE MOTORS IN STOCK

Can ship unlisted gearmotors 1 to 25 HP in 2 to 4 weeks, practically all ratings.

Also, good stock of rebuilt gearmotors from ½ HP to 40 HP

Prompt Detailed Replies to All Inquiries

SANDMAN ELECTRIC COMPANY, INC.
NEW ENGLAND'S LEADING MOTOR DEALER
166 Oliver St. Boston 10, Mass.

ENGINE GENERATORS

DIRECT CURRENT

125, 100, 75, 50, 25, 10, 8½, 5 K.W.

In our warehouse,

Skidded — ready for use.

OPEN FOR OFFERS.

WASHINGTON ELECTRIC CO. Inc.
14 Astor Place, New York, 3, N. Y.

BOILERS

10 to 1000 H. P.

NEW-USED
RECONDITIONED

Steam, Gas and Electric Power Equipment

J. PARKER THOMPSON CO., INC.
507 FIFTH AVE., NEW YORK CITY
MURRAY HILL 7-6547-8-9

MODERN 500 KW FAIRBANKS-MORSE GENERATING PLANT

1—450 HP 6 cylinder Diesel engine, series 32-E-14, 300 RPM, direct connected to 300 KW Fairbanks-Morse generator, 240 volt, 3 phase, 60 cycle.

1—300 HP 4 cylinder Diesel engine, series 32-E-14, 300 RPM, direct connected to 200 KW Fairbanks-Morse generator, 240 volt, 3 phase, 60 cycle.

Installation is complete with switchboard, exciters, volt meters, starting equipment, synchronoscope, Woodward governors and cooling equipment. Units can be operated for inspection. Immediate delivery.

DENNY & CLARK
1923 W. NORTH AVENUE
CHICAGO 22, ILLINOIS

FOR SALE

1—New Elmes 6 Plunger Horizontal High Pressure Pump

250 GPM, 1800 PSI, 50 PSI Intake Pressure
MODEL 5935
$2200.00 F.O.B. Anderson
GLAZER BROS PH. 20233 ANDERSON, IND.

FOR SALE

1—100 HP—Hewes & Phillips—Corliss Engine—16 x 30E—right hand: 100 lbs. initial steam pressure, 5 lbs. back pressure, 100 RPM, good condition. Available January 15, 1949.

ZINSSER & COMPANY, INC.
Hastings-on-Hudson, N. Y.

COMPLETE POWER PLANTS

STEAM-ELECTRIC-HYDRO-DIESEL—*"Export Orders Carefully Executed"*

2—135,000# Steam Generators 450# or 200#
2— 60,000# Steam Generators 450# or 200#
2— 30,000# Steam Generators 450# or 200#
4—1000 HP Heines with superheat 200#
2— 825 HP B&W Co. Stirlings, Super, 200#
2— 500 HP B&W Co. Stirlings, 160#
2— 600 HP B&W Co. Sectional, Super 350#
2— 450 HP B&W Co. Sectional header 200#
3— 310 HP Stirlings 180#

FIRE TUBE BOILERS
Various Types and Sizes

OUR EXPORTS

have included several complete POWER PLANTS, Complete Boiler Plants, Complete Turbo-generator Plants, many Boilers, Turbo-generators, Transformers, etc., Shipped to Porto Rico, Cuba, Mexico, Brazil, Peru, Argentina, China and other Countries.

TRANSFORMERS, M-G SETS

1—6000 KW Unit Condensing 235#
1—5000 KW Unit Condensing 235#
2—5000 KW Units Condensing 200#
1—4000 KW Unit Condensing 200#
2—2500 KW Units Condensing 200#
2—1500 KW Units Condensing 200#
2—1250 KW Units Condensing 200#
Several 1000 KW, 750 & 500 KW Cond.
Non-Cond. 300-500-750-1000-1500-2000-2700 KW
FREQUENCY CHANGERS—600, 1250 & 1500 KVA.

CHARLES B. REARICK

30 CHURCH ST. NEW YORK 7

TRANSFORMERS

QU.	KVA	MAKE	FORM	TYPE	HV	LV	PH	
96	1½	Maloney	Dry	TF5V	480/240	120/240	1 new	
32	3	G. E.	KR	H	7200/12470Y	120/240	1	
6	3	Whse.	Dry	AJR	230/115	230/115	1 new	
22	5	G. E.	KR	H	7200/12470Y	120/240	1	
6	7½	G. E.	KR	H	7200/12470Y	120/240	1	
24	10	G. E.	KR	H	7200/12470	120/240	1	
2	10	Al. Chal.	Dry		440	110	1 new	
18	15	G. E.	KR	4	7200/12470	120/240	1	
2	15	Maloney	Dry		440/220	220/110	1 new	
33	25	G. E.	KR	H	7200/12470Y	120/240	1	
1	25	G. E.		H	440	220	3	
3	25	G. E.	Dry		440	110	1 new	
48	37½	G. E.	KR	H	7200/12470Y	120/240	1	
3	37½	Whse.	Dry	AJR	440	110	1 new	
3	50	G. E.	KR	H	2400/4160Y	120/240	1	
2	50	G. E.	Dry	75G	440	120	1 new	
58	50	G. E.	KR	H	7200/12470Y	120/240	1	
3	75	G. E.	KR	H	7200/12470Y	120/240	1	
4	100	G. E.	KR	H	7200/12470Y	120/240	1	
1	100	Niagra	OISC		22000	2200	3 new	
1	150	Niagra	OISC	H	33000	3300	3 new	
4	150	Uptegraff		OISC	30000	3300	3 new	25 cy.
5	300	Upt graff		OISC	33000	7200/12470Y	3 new	
3	333	Maloney	OISC		11000	2300	1	
3	500	Whse.	SL	OISC	2400	240/480	1 new	
4	1000	Whse.	SL	OISC	44000	11000/9990	1	
6	1500	Wagner	BGSS	17RRB	44000	6900/11950Y	1 new	

The above represents one of the largest dealer stocks in the United States. We have them; also others. If you don't see listed what you want please wire or write.

1350—45 ft. Western Cedar poles, cross arms and insulators.
10—90/135 volt, 1 ph, 60 cy, Cat 69G102, 110/115/120 volt output, GE voltage stabelizers, NEW.
1—40 KW, 60 V, DC, GE, dir. dr. 60 HP, 1200 RPM, 440 V, Type TS, GE Synchron. motor, MG set with control and starting.
1—125 KW, 250 V, 860 RPM, GE M-G set with 440 V Sq Cg. motor.
2—400 KW, 550 V, 600 RPM, MP, DC, GE, M-G sets with 600 HP I-K, GE, 2300 Volt motors, starters, control.
2—350 H.P., 4000 Volt, CR1034G1A, 3-60, GE Compensators.
2—1000 Lb. pressure, 500 GPM, 8 stage Goulds pumps with motors.
86—5 to 1, 5 HP, Type 3750H, W. A. Jones, Speed reducers, new.
1—25 Ton, 38 Ft. Rad., Willey stiff leg derrick, Jaeger double drum hoist, UD18 Int. diesel engine, nearly new, 58 ft. boom.
3—500 Amp, 440/220, AC, Westinghouse Stabel-Arc Welders.
2—1½ Bbl., 15/7½ HP Peerless Dough Mixers, nearly new.

MOTORS - GENERATORS - TRANSFORMERS - BOT - SOLD - RENTED

WAYNE ELECTRIC & MFG. CO.,

344 West Eighth South St., *PH. 5-5224* Salt Lake City, Utah

FOR SALE

1—Used Allis Chalmers Vertical Hydraulic Turbine, 340 BHP, 12 ft. head and Allis-Chalmers generator, 312 KVA, 2300 Volts 222 RPM, 3 phase, 60 cycle, with governor and switchboard panel. Located southeastern Minnesota.

Write **FS-7059**, Power
520 N. Michigan Ave., Chicago 11, Ill.

COMPRESSOR

Westinghouse 10½" cross compound, 150 cubic ft. displacement. Installed new 1944. *Excellent Condition.*

M. J. HUNT'S SONS
1600 N. Delaware Ave., Phila. 25, Pa.

FOR SALE

We offer—200 Gearmotors

Westinghouse, 2 h.p. totally enclosed, ball bearing. Parallel shaft, frame 225, 3/60/220/440, Rebuilt and Guaranteed.
SURPLUS & SALVAGE CO. INC.
JAMESTOWN, NEW YORK

FOR SALE

FAIRBANKS MORSE DIESEL ENGINE GENERATING PLANT

ENGINES				GENERATORS				
Number	*H P*	*Type*	*RPM*	*KVA*	*Volts*	*Cycle*	*Phase*	*Make*
2	150	YV	257	60	230	60	3	F-M
1	100	YV	257	72	230	60	3	F-M
1	75	YV	300	62.5	240	60	3	West
1	210	VA	300	150	240	60	3	West

ALL NOW OPERATING AND IN GOOD CONDITION. PRICED LOW FOR QUICK DISPOSAL.
F.S.-6796, Power, 330 West 42nd St., New York 18, N. Y.

FOR SALE

1—GENERAL MOTORS DETROIT DIESEL TWIN POWER UNIT

Model 12103. Practically new.
Write for complete specifications
NEW YORK TRAP ROCK CORPORATION
230 Park Avenue New York 17, N. Y.

FOR SALE

STEAM DRIVEN COMPRESSOR

LAID LAW DUNN GORDON — HORIZONTAL
2 cyl. single stage—Tandem 13/22 x 16 x 18 Compound Engine—Operate on 150# steam. Good condition.

FS-5180, Power
330 West 42nd Street, New York 18, N. Y.

DIESEL-GENERATORS

5 KW. TO 1000 KW.
NEW-USED
RECONDITIONED

J. PARKER THOMPSON CO., INC.
507 FIFTH AVE., NEW YORK 17, N. Y.
MURRAY HILL 7-6547

A. C. ENGINE GENERATORS

150 KW Erie Ball
125 KW Ames
75 KVA Harrisburg
70 KW Harrisburg
50 KW G.E. Vertical
50 KW Harrisburg

Other power plant equipment. Send us your requirements.

WASHINGTON ELECTRIC CO. Inc.

14 Astor Place, New York 3, N. Y.

FOR SALE—LOW PRICE

1—125 KVA Steam Engine Generator Set 240 volts, 60 cycles, 3 phase, 277 R.P.M. Includes Burke Electric Co. A.C. generator mounted on engine subbase with 14" x 14" Erie City Iron Works Co. engine with Baker piston valve gear and flywheel governor. Belt type exciter. Location is New York City.

HUGH A. BROWN
Sales Agent
235-39 36th Ave. Douglaston, L. I., N. Y.

WANTED

WANTED
BOILERS
DIESELS
TURBO-GENERATORS
POWER EQUIPMENT
What have you to offer?
J. PARKER THOMPSON CO., INC.
507 FIFTH AVE., NEW YORK CITY
MURRAY HILL 7-6547-8-9

Air Compressors Wanted
Horizontal Water Cooled—Any size
also 2 Stage portable units
L. W. BAUER
North Bergen, N. J.

BOILERS WANTED
Any Condition - Anywhere
USABLE OR OBSOLETE STEAM & ELECTRICAL MACHINERY PURCHASED, DISMANTLED & REMOVED.
Men-Tools-Insurance - 30 Yrs. Experience

E. M. LINDER CO.
322 E. 33rd St.
New York 16, N. Y.
Tel. MU 6-9635
'We Can Dismantle Anything Made of Metal'

WANTED IMMEDIATELY
SUBSTATION EQUIPMENT
100 to 750 KW Rotary Converters, 275 or 600 volts D.C.; Mercury Arc Rectifiers; Motor-Generator Sets; Accessories. State full information.
R. H. BENNEY EQUIPMENT CO.
Norwood 12, Ohio

ENGINEER-GRADUATE
EXCELLENT OPPORTUNITY FOR YOUNG ENERGETIC ENGINEER WHO HAS HAD OPERATING AND DESIGN EXPERIENCE ON LARGE STEAM GENERATORS AND WHO WANTS TO ADVANCE. GIVE AGE, EXPERIENCE AND EDUCATION. EASTERN LOCATION.
P-7072 Power
330 West 42nd St., New York 18, N. Y.

MECHANICAL ENGINEERS
WITH 5 TO 15 YEARS EXPERIENCE
In Steam or Gas Plant Design
Write To
MECHANICAL ENGINEER
Pennsylvania Power & Light Company
Allentown, Pa.

WANTED
2—Diesel generator sets 220/3/60, one 300-Kva., one 200-Kva.
1—100 H.P., 2200/3/60/1800 T.E.F.C.
1—30-H.P., 220/440/3/60/1200, B.B. explosion proof motor & starter.
1—75-H.P., 220/3/60/900 preferred, Squirrel Cage.
1—20-H.P., 220/3/60 T.E.F.C. Squirrel Cage.
1—250-Kw., (approx.) steam engine generator or steam turbine set, 550/3/25 complete unit or generator alone.
3—1000-Kva., 60/1 transformers, 22000 to 575-volts.
2—300-H.P., 550/3/60 Slip ring motors complete with control, approximately 600-R.P.M. preferred.
We have been selling power machinery here for 38 years. We frequently find an outlet for machines that would be slow moving elsewhere.

We specialize in Electric Power Mining Machinery
and urge you to send your lists of surplus equipment of any kind. We have urgent outlets for:
Several carloads of wire nails
Miles of pipe, all sizes, for oil, natural gas and water work extension.
Several carloads of rails, 30#, 35#, 40#, 72#.
Gravel handling and dirt moving equipment.
Packing house and food processing equipment.
Pumps of all kinds.
We have been surprising many important industries by locating precious machinery, new and second hand for immediate delivery.
SOUL CLINIC INC., Calgary, Alberta, Canada
Formerly Guy Morton Company

SEARCHLIGHT SECTION
(Classified Advertising)
SELLING : EMPLOYMENT : **"OPPORTUNITIES"** : MERCHANDISE : BUSINESS

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

STRESS ANALYSTS: Graduate in mechanical engineering or physics with five to ten years experience in theoretical or experimental stress analysis, preferably on pressure vessels and heat exchange equipment. Knowledge of thermal stresses desirable. Excellent opportunity for qualified man in new Research and Development Department Laboratory. Write, giving resume of education and experience. The Babcock & Wilcox Company, Research & Development Dept., Alliance, Ohio.

POWER PLANT Supervisor: Experienced in oil fired boilers and in all accessories connected with Boiler Plant. Must be able to figure boiler efficiencies and must have knowledge of operating stand-by turbines and electrical switching equipment. Location in central Connecticut. P-7026, Power.

ASSISTANT SUPERVISOR—Power Station—Should be at least 30 years old and have technical education — also experience with operation and maintenance high-pressure, high-temperature power station equipment. Location Central Illinois. P-6487, Power.

(Continued on page 346)

CONSTRUCTION SUPERINTENDENTS
Large engineering organization desires construction engineers. Must have considerable recent experience in steam-electric power plant construction, and be thoroughly qualified to direct field layout work, preparation of construction reports and specifications for subcontracts. Submit complete experience record.
P-6062, Power
330 West 42nd Street, New York 18, N. Y.

WANTED MANUFACTURER'S REPRESENTATIVE
to contact coal-burning industrial institutions to distribute Today's Coal Bill Reducer (for high pressure boilers) which pays for itself quickly. Sales and combustion engineering experience desirable.
Address — P. O. Box 1367 — Chicago, Ill.

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE

(Not available for equipment advertising) $1.20 a line, minimum 4 lines. To figure advance payment, count 5 average words as a line.
POSITIONS WANTED (full or part-time individual salaried employment only), ½ the above rates.
PROPOSALS, $1.20 a line an insertion.

INFORMATION

BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count 1 line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:

The advertising rate is $10.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅛ inch vertically on one column, 3 columns—30 inches—to a page. P.

NEW ADVERTISEMENTS received by December 2nd will appear in the January issue, subject to limitation of space available.

POSITIONS VACANT

(Continued from page 345)

RESEARCH DESIGNER: For the design of experimental apparatus. Each apparatus is designed individually to provide the conditions desired for the specific problem. These problems deal with applied research on heat transfer; metals under simulated service conditions; flow of water, steam and air, experimental stress analysis. Degree in engineering or physics with about five years experience in research or development is desirable. The Babcock & Wilcox Co., Research & Development Department, Alliance, Ohio.

WANTED: ENGINEER for design and installation of steam and electrical equipment in new plant of expanding industry. After construction, man selected will have possible opportunity as plant engineer. Complete information required in first letter. All details confidential. P-6784, Power.

RESEARCH ENGINEERS: With degree in Mechanical Engineering or Physics and five to ten years experience in research or development work. For applied research on the flow of water, steam and air; metals under simulated service conditions; heat transfer; experimental stress analysis; all as applied to steam boilers and related equipment. Unusual opportunity for men in new research and development laboratory. The Babcock & Wilcox Co., Research & Development Department, Alliance, Ohio.

WANTED, SEVERAL Engineering graduates, under 35, by large industrial fire prevention organization maintained by leading insurance group. Permanent position. Periodic inspections and special consulting service for leading industrial plants. Thorough training. P-6940, Power.

WANTED. GRADUATE Electrical Engineer with experience in design, layout and maintaining electrical equipment and power distribution. Must be able to plan and direct the engineering of electrical work in plant with 2,300 volt, 5,000 KW generation. Middle Eastern location. P-6945, Power.

ENGINEERS: LARGE college offers $3,000, approx. half time teaching-studying. All ranks univ. positions, experienced $4500-$6500 nine months. Give photo, qualifications. Cline Teachers Agency, East Lansing, Mich.

WANTED—ASSISTANT to Chief Engineer—A graduate engineer with power plant and mechanical engineering experience for Board Mill and Converting Plant in Middle West. P 7073, Power.

CHIEF ENGINEER wanted by a food processing concern to take charge of operation and maintenance of power plant and manufacturing equipment and of buildings. Must have or be able to get First Class New Jersey license. A thorough knowledge of boiler operation and refrigeration absolutely necessary. Application should furnish vital statistics, outline of education and experience and salary expected. Location Metropolitan area. P 7071, Power.

CHIEF ENGINEER—Power Station—To take charge of 100,000 kw 1250 lb. steam turbine station now being constructed in Middle West area—should have experience with operation and maintenance 1200 lb. high temperature power station equipment, also experience successfully directing station operating organization. References required. P-6486, Power.

EMPLOYMENT SERVICES

SALARIED PERSONNEL, $3,000-$25,000. This confidential service established 1927, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 241 Orange St., New Haven, Conn.

CHIEF ENGINEER and MANAGER

Burma Electricity Supply Department

Applications are invited for position of Chief Engineer and Manager, Burma Electricity Supply Department, Rangoon, Burma. Applicants should be (1) member of American Institute of Electrical Engineers; (2) experienced in organization commercial and general management of large electric power company; (3) experienced in both urban and rural distribution systems at both high tension and ordinary voltages; (4) experienced with Diesel engine generation in small units, steam generation in units up to 10,000 KW; and (5) have knowledge of hydro-electric development and planning.

Salary Rs 2,500 to Rs 3,000 ($750. to $900.) per month according to qualifications and experience. Contract proposed for five year basis subject to reasonable termination clauses. Traveling expenses to and from Burma for selected candidate and his family will be provided, also one month's extra pay yearly at completion of contract, also leave of absence with pay one month per year; free medical attention and provision to take out of Burma up to as much as two-thirds of earnings.

Applications to be sent to His Excellency, the Burmese Ambassador, 2228 Massachusetts Avenue, N. W., Washington, D. C. before December 10, 1948.

Candidates must be prepared to come to Washington for interview if required.

All applications should contain full information on qualification, experience, a photograph, names and addresses of references and documentary evidence of age.

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SALARIED POSITIONS $3,500-$35,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service (38 years recognized standing and reputation). The procedure, of highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 270 Dun Bldg., Buffalo 2, N. Y.

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POWER ENGINEER with supervisory ability desires change. Over sixteen years experience operating power plant equipment both as service engineer for equipment manufacturers and power plant supervisor. Well grounded technically in power plant operation. Excellent references. PW-7040, Power.

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PW 7053 Power
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OFFICIAL PROPOSALS

Bids: April 1, 1949 (100)

Aswan Dam Hydro-Electric Scheme

EGYPTIAN GOVERNMENT
MINISTRY OF PUBLIC WORKS
HYDRO-ELECTRIC POWER COMMISSION

ADJUDICATION FOR CIVIL ENGINEERING CONTRACT

The Egyptian Government hereby announces that Tenders will be invited early in 1949 for the building and Civil Engineering Works involved in the construction of a Hydro-Electric Power Station at the Aswan Dam. It is expected that complete documents will be issued on or about 1st January 1949 and that tenders will be received on the 1st April 1949. In order to give prospective Tenderers an early opportunity of visiting the site and beginning their investigations on sources of materials and methods of carrying out the work, a preliminary document has been prepared giving a general description of the works with a note of the approximate quantities involved.

This preliminary document may be obtained free of charge, either at the Hydro-Electric Power Department, Ministry of Public Works, Street Maamal-El-Sukar, Kazr-el-Dubara, Cairo, or at the office of the Consulting Engineers of the Egyptian Government, Messrs. Kennedy & Donkin, 12 Caxton Street, London S.W. 1, or from the Egyptian Embassies in Washington, D. C., Paris, France, or the Egyptian Legations in Stockholm, Berne, Brussels and Prague, as from October 20th, 1948.

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Plenty!

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Here, Hector is making doubly sure that the operator of this giant shear is meeting every specification. And in the traditional American Blower manner, skilled craftsmen—men who have spent years in making power plant equipment—will check at every stage of the job to be sure that no detail is overlooked or left undone.

Hector Dick's viewpoint is typical of the attitude which is encouraged in all workers at American Blower. It is reflected over and over again in every step of design and fabrication. This goes a long way to insure every customer greater overall power plant efficiency and years of dependable performance.

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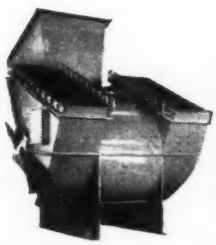

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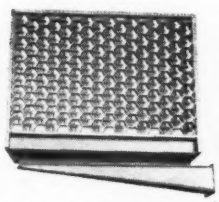

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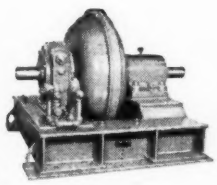

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ADVERTISERS' INDEX

Where an * appears after a name the advertisement does not appear in this issue, but appeared in preceding issues

Air Preheater Corp. ..... *
Air Express Div., Railway Express Agency 174
Allen-Sherman-Hoff Co. .....Second Cover
Allis-Chalmers Mfg. Co. 34, 46-47, 52, 167, 199
Alloy Steel Products Co., Inc. ..... *
Alpax Co. 186
American Blower Co. 347
American Brass Co. 139
American Chain & Cable Co. 269
American Chimney Corp. ..... *
American District Steam Co. 166
American Engineering Co. 35, 65
American Locomotive Co. ..... *
American Manganese Steel Div. ..... *
American Pulverizer Co. 207
Anchor Packing Co. 197
Anderson Co., V. D. ..... *
Arco Co. ..... *
Arkansas Fuel Oil Co. 255
Armstrong Cork Co. 266
Armstrong Machine Works 157
Associated Research, Inc. 298
Atlas Valve Co. 204
Aurora Pump Co. 178
Automatic Control Co. ..... *

Babbitt Steam Specalty Co. 218
Babcock & Wilcox Co. 4-5
Badger & Sons Co., E. B. 230
Bailey Meter Co. 12-13
Baldwin-Hill Co. ..... *
Bartlett Hayward Div., Koppers Co. .... *
Bartlett & Snow Co., C. O. 267
Beaumont Birch Co. 186
Belco Industrial Equipment Div. ..... *
Bell & Gosset Co. 257
Belmont Packing Co. 210
Bernitz Furnace Appliance Co. 283
Betz Co., W. H., & L. D. 137
Biddle & Co., James G. ..... *
Bigelow-Liptak Corp. 264
Birch Mfg. Co. ..... *
Bird-Archer Co. 282
Black, Sivalls & Bryson Co. ..... *
Blaw-Knox Co. 179
Boiler Tube of America 296
Boston Woven Hose & Rubber Co. 254
Bridgeport Brass Co. 299
Bros Boiler & Mfg. Co. Wm. 286
Brown Instrument Co. 215
Buell Engineering Co. 284
Buffalo Forge Co. 219
Buffalo Pumps, Inc. 181
Buhler Bros, Inc. 349
Bussmann Mfg. Co. ..... *
Byers Co., A. M. 70

Carborundum Co. ..... *
Cardox Corp. 180
Carey Mfg. Co., Philip ..... *
Cash Co., A. W. 294
Catawissa Valve & Fittings Co. 216
Chapman Valve Mfg. Co. 165
Chase Brass & Copper Co. 175
Chicago Metal Hose Corp. 293
Chicago Pneumatic Tool Co. ..... *
Cities Service Oil Co. 255
Clarage Fan Co. 297
Clark Mfg. Co. 198
Cleaver-Brooks Co. 273
Cochrane Corp. 40-41
Coffin Jr. Co., J. S. 195
Combustion Engineering Co. 10-11
Coppus Engineering Co. ..... *
Corning Glass Works 220
Crane Co. 143
Cryer Trap & Valve Co. 196
Cyclotherm Corp. 291

Dampney Co. of America ..... *
Darling Valve & Mfg. Co. ..... *
Dart Mfg. Co., E. M. 194
Davey Compressor Co. 178
Davis Engineering Co. ..... *
Davis Regulator Co. ..... *
Dearborn Chemical Co. 229
DeLaval Separator Co. 233
DeLaval Steam Turbine Co. 66, 204
Detroit Stoker Co. 56-57
Diamond Power Specialty Corp. 8-9
Dings Magnetic Separator Co. ..... *
Dodge Mfg. Corp. 276
Dowell, Inc. ..... *
Dravo Corp. 155, 182
Drew Co., Inc., E. F. 265
Dudgeon, Inc., Richard 306
Dutton Co., C. H. ..... *

Eagle-Picher Co. ..... *
Eastern Gas & Fuel Asso. 225
Economy Pumps, Inc. 289
Edward Valves, Inc. 131
Eisler Engineering Co., Inc. 216
Electric Machinery Mfg. Co. 54-55
Electric Storage Battery Co. 227
Elgin Softener Corp. 247
Elliott Co. 6-7
Engineer Co. 281
Erie City Iron Works 275
Ernst Water Column & Gauge Co. 304

Fairfield Engineering Co. 161
Fairmont Coal Bureau 241
Filtrol Corp. 300
Flader, Inc., Fredric ..... *
Flexo Supply Co., Inc. ..... *
Flynn & Emrich Co. 242
Foster Engineering Co. .....Back Cover
Foster Wheeler Corp. 21-22-23
Foxboro Co. 244
Frederick Iron & Steel Co. ..... *
Frick Co. 196
Fuller Co. 188

Garlock Packing Co. 279
General Coal Co. ..... *
General Controls Co. 302
General Electric Co. (Apparatus Dept.) .28-29, 34A-34B, 58-59, 212
Gifford-Wood Co. ..... *
Globe Steel Tubes Co. 239
Golden-Anderson Valve Spec. Co. 203
Goodyear Tire & Rubber Co. ..... *
Goulds Pumps, Inc. 228
Grinnell Co. .....Third Cover
Griscom-Russell Co. 292
Gulf Oil Corp. 223
Gulf Refining Co. 223
Gunite Concrete & Construction Co. 204

Haering & Co., D. W. ..... *
Hagan Corp. 16-17, 177
Hall Laboratories 50-51
Harbison-Walker Refractories Co. 277
Haynes Stellite Co. 285
Hays Corp. 42-43
Hays Institute of Combustion. ..... *
Heacon, Inc. 183
Heating & Ventilating & Air Condi-tioning Exp. 176
Hendrick Mfg. Co. ..... *
Henszey Co. 192
Hewitt Rubber Div., Hewitt-Robins, Inc. 259
Heyl & Patterson, Inc. ..... *
Hill Pump Valve Co. ..... *
Hoffman Combustion Engrg. Corp. 44-45
Hoffman Specialty Co. ..... *
Homestead Valve & Mfg. Co. ..... *
Honan-Crane Corp. ..... *
Hoppes Mfg. Co. 306

Illinois Water Treatment Co. 208
Infilco, Inc. ..... *
Ingersoll-Rand Co. 235
International Nickel Co. 209
Iron Fireman Mfg. Co. 173

Jefferson Union Co. 182
Jeffrey Mfg. Co. 234
Jenkins Bros. 148-149
Jerguson Gage & Valve Co. 206
Johns-Manville, Inc. 153
Johnston Bros., Inc. 304
Jones Foundry & Machine Co., W. A. ... 262
Joy Mfg. Co. ..... *

Keasbey & Mattison Co. 226
Kellogg Co., M. W. 245
Kennedy Valve & Mfg. Co. 246
Kennedy-VanSaun Mfg. & Engrg. Corp. .24-25
Kewanee Boiler Corp. 220
Klipfel Mfg. Co. 289
Koppers Co. ..... *

Ladish Corp. 168-169, 300
Leeds & Northrup Co. ..... *
Leffel & Co., James 302
Lientz & Co., B. P. 263
Lincoln Electric Co. ..... *
Link-Belt Co. 3
Liquidometer Corp. ..... *
Lummus Co. 270
Lumnite Div., Universal Atlas Cement Co. 252
Lunkenheimer Co. 38-39

Madden Co., P. E. 212
Manheim Mfg. & Belting Co. 232
Manning, Maxwell & Moore, Inc. 306
Manzel, Inc. ..... *
Marley Co. 211
Marsh Corp., James P. ..... *
Mason-Neilan Regulator Co. ..... *
Maxim Silencer Co. ..... *
McDonnell & Miller, Inc. 298
McGraw-Hill Book Co. 296
Mercoid Corp. 216
Midwest Piping & Supply Co. 231
Milton Roy Co. 274
Minneapolis-Honeywell Reg. Co. ..... *
Mitchell & Co., W. K. 189
Modine Mfg. Co. 170
Monsanto Chemical Co. ..... *
Murray Iron Works Co. 303

National Aluminate Corp. 147
National Electric Coil Co. ..... *
National Tube Co. 272
National Valve & Mfg. Co. 213
Niagara Blower Co. 200
Nicholson Co., W. H. 214
Nordberg Mfg. Co. 301
Northern Equipment Co. 151
Norton Co. ..... *
Nugent & Co., Inc., W. W. 289

Ohio Coal Association ..... *
Ohio Injector Co. ..... *

Pacific Pumps, Inc. ..... *
Peabody Engineering Co. ..... *
Peerless Pump Div., Food Machy. & Chemical Corp. 218
Pennsylvania Crusher Co. 260
Penn Flexible Metallic Tubing Co. 256
Permutit Co. 253
Philadelphia Gear Works, Inc. 268
Pipe Fabrication Institute. 187
Pittsburgh Piping & Equipment Co. 290
Pittsburgh Steel Co. 201
Powell Co., Wm. 48-49
Powers Regulator Co. 261
Prat-Daniel Corp. 53
Preferred Utilities Mfg. Co. 278
Pritchard & Co., J. F. ..... *

Quaker Rubber Co. ..... *

Raybestos-Manhattan, Inc., Packing Div. 236
Reading, Pratt & Cady Div. 269
Reliance Gauge Column Co. 36-37
Republic Flow Meters Co. 30-31
Republic Rubber Div., Lee Tire & Rubber Co. ..... *

Republic Steel Corp. 62-63
Research Corp. 288
Revere Copper & Brass, Inc. 145
Richardson Scale Co. 184
Ric-Wil Co. 250
Riley Stoker Corp. 119A-119B
Robins Conveyors Div., Hewitt Robins, Inc. 259
Rockbestos Products Corp. 280
Roto Div. of Elliott Co. ..... *

Sarco Co. 191
Schramm, Inc. 202
Schutte & Koerting Co. 141
Shaw Co., B. F. 193
Sier-Bath Gear & Pump Co. 222
Simplex Valve & Meter Co. ..... *
Sinclair Refining Co. ..... *
Skinner Engine Co. ..... *
Smith Refractories, Sanford C. 304
Socony-Vacuum Oil Co. 163
Springfield Boiler Co. 61
Standard Oil Co. of Calif. 237
Standard Oil Co. of Indiana 26-27
Steel & Tubes Div. 62-63
Stephens-Adamson Mfg. Co. 64
Sterling Engrg. & Mfg. Co. ..... *
Stickle Steam Specialties Co. ..... *
Stock Engineering Co. ..... *
Stone & Webster Engrg. Co. 251
Strong, Carlisle & Hammond Co. 172
Strong-Scott Mfg. Co. ..... *
Struthers Wells Process Equip. Dept. 305
Sturtevant Div., Westinghouse Electric Corp. 32-33
Sun Oil Co. 135
Superior Combustion Industries 240
Swartwout Co. 350
Sweet's Catalog Service ..... *
Syntron Co. ..... *

Taylor Forge & Pipe Works 271
Taylor Instrument Co's. ..... *
Templeton Bros. ..... *
Terry Steam Turbine Co. 258
Texas Co. 159
Thermix Corp. 53, 183
Tidewater Associated Oil Co. 248
Timken Roller Bearing Co. ..... *
Todd Shipyards Corp., Combustion Equipment Div. ..... *
Trimont Mfg. Co. ..... *
Troy Engine & Machine Co. ..... *
Tube-Turns, Inc. ..... *

Union Carbide & Carbon Co. 285
Union Chain & Mfg. Co. 287
Union Iron Works 243
U. S. Steel Corp. 272

Viking Pump Co. ..... *
Vogt Machine Co., Henry 205
Vulcan Soot Blower Corp. 14-15

Wallace & Tiernan Products, Inc. 217
Walworth Co. 238
Warren Steam Pump Co. 224
Watson-Stillman Co. ..... *
Webster Engineering Co. 298
Western Chemical Co. ..... *
Westinghouse Electric Corp. 68-69
Weston Electrical Instrument Corp. 121A-121B
Wheeler Mfg. Co., C. H. 160
Where to Buy 185
Wickes Boiler Co. 304
Wiedeke Co., Gustav 249
Wiley & Sons, Inc., John 214
Williams Gauge Co. 218
Wilson, Inc., Thomas C. 182
Wing Mfg. Co., L. J. ..... *
Worthington Pump & Machy Corp. 164
Wright Chemical Co. 20
Wrigley, Jr., Co., Wm. 60, 171

Yarnall-Waring Co. 18-19, 133, 162
Youngstown Sheet & Tube Co. 221

Zallea Bros. 190

PROFESSIONAL SERVICES 304

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT
Positions Vacant 345
Selling Opportunities Offered 345
Positions Wanted 346
Employment Services 346

NOTICES
Legal 328
Proposal 346

EQUIPMENT
(Used or Surplus New)
For Sale 305, 344

WANTED
Equipment 345
Bauer, L. W. 345
Benney Equip. Co., R. H. 345
Linder, G. M. 345
Soul Clinic Inc. 345
Thompson Co., Inc., J. Parker 345

ADVERTISERS INDEX 307

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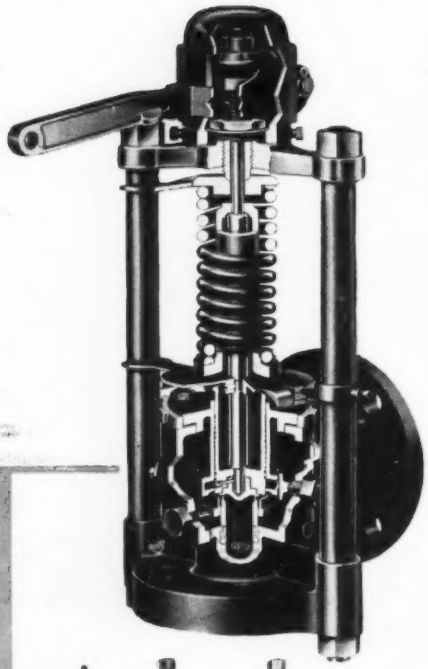

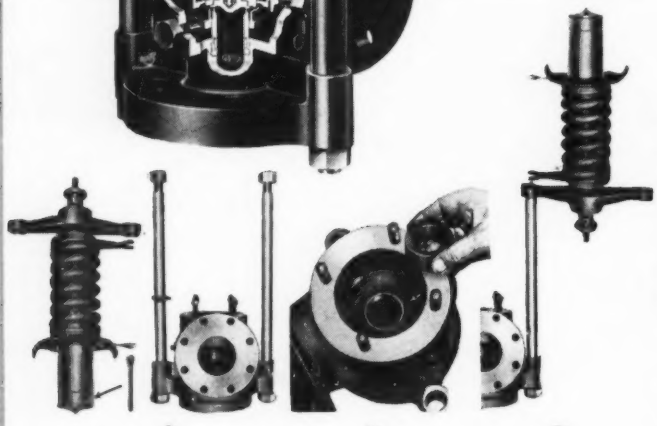

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B. With the loading assembly removed, the flat seating surfaces of both nozzle and disc are readily accessible, and in most cases can easily be lapped ON THE JOB with a simple ring-shaped lapping block. For this operation, loading assembly may be inverted and securely mounted on frame rod. It is unnecessary to take it to the shop.

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